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SOME BEGINNINGS OF SPECIFIC DIFFERENTIATION IN PLANTS[1]

By Dr. M. L. FERNALD

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IN these days, when the followers of some of our youthful and consequently aggressive branches of biology actually work with but few specific entities and often spend half a life-time experimenting with the vagaries of a single one under highly artificial, if not pathological conditions, we are likely to gain a distorted conception of what a species really is. Some of my friends who have had little or no broad taxonomic background and whose interest in plants awoke in the laboratory, not out-of-doors, toss about the terms species and speciation with an assurance which the more thoughtful of taxonomists have learned to avoid. It should really be remembered, however, that, although never capable of rigidly exact definition, the species has been for centuries the primary concept of the taxonomist. In fact, two centuries ago, the great organizer of the accumulated knowledge in the natural sciences, Linnaeus, so far glorified the species as to write: "The tyro makes systems, the expert makes species."

The taxonomist, who once was the only botanist, now welcomes among a host of young brothers that increasing body of modern biologists who think chiefly of genes; but it is sometimes a bit shocking to him to be assured by them that, by drastic chemical, physical or pathological manipulations within their restricted laboratory walls, they have produced something which might be termed a new species. Perhaps; but it seems improbable that their "creations," put

[1] Read by invitation at the joint session of Section G and the affiliated Botanical Societies, at the fifth Boston meeting, December 28, 1933.

to the test, would be able to strike out into the world and successfully to hold their own, as the great majority of real species have done for millions and millions of years, in spite of wholesale physiographic changes which have altered the contours and boundaries of the continents, the positions of the seas and the temperatures of the thin stratum in which the plant-species have to live. Some of the Jurassic and early Cretaceous fossils of *Ginkgo* are apparently indistinguishable from the living *Ginkgo biloba;* Cretaceous species of *Platanus* show, to quote Seward, "almost specific identity with existing trees"; and innumerable species of Tertiary origin are still prospering, for example, the American beech, *Fagus grandifolia,* which dominates much of eastern North America. Unlike the temporary mutations of a few helpless prisoners in the laboratory, they have faced the actual world and have withstood the relentless test of competition. There are real species for you!

Although I would not for a moment imply disrespect for the painstaking efforts of my gene-hunting associates, I confess to being so old or so old-fashioned as to have more faith in the permanency of results of the slow processes of nature than in the swift and sometimes impatient ones of man; and I can not help feeling that a large experience with plants as they occur in their natural environments is more likely to give us a true evaluation of evolution than are the closet experiments on organisms under conditions which are too often not really natural and which can hardly ever be completely so.

It is, therefore, for close observation of plants in nature that I am pleading. Not long ago the taxonomist who worked only on dried material (usually the only material he can preserve and satisfactorily store for repeated comparisons) and never saw the plants in their natural surroundings was maliciously called a "closet botanist." The type is not extinct, but it is possible that the term should be applied outside the field of taxonomy. Another group is growing up: the taxonomists who do as much field-work as herbarium-study and who, consequently, reenforce their long and arduous routine in the herbarium with intimate field-experience. It is this group, taxonomists with a knowledge of natural conditions, who, perhaps, can throw some light on the great problem of specific evolution. I am, therefore, asking you to review with me a very few of the simple responses of some common plants to natural changes of environment.

Many plants are so stable in their characters and so conservative or so dependent in their requirements that their inevitable response to change of environment is death and extinction. Of such are the majority of saprophytes, the species with mycorrhiza and the highly localized relic-species. Others, more plastic, respond by certain predictable modifications of the vegetative habit. The sensitive fern, *Onoclea sensibilis,* although seventy to one hundred million years old (or older), still fluctuates within a limited and definite range of variation. Overfeed it or stimulate it to new growth and the chances are, as every observant field-naturalist knows, that it will change from the ordinary type with sharply differentiated sterile and fertile fronds to the forma *obtusilobata,* in which one of them becomes altered. Any experimenter, unaware of the frequency of this reaction in *Onoclea* and other dimorphic ferns, might well suppose that he had created a new species; one of the most scholarly of pioneer taxonomists, Christian Schkuhr, knowing the plant only from a strange specimen in a European collection, so treated it. Had he known it with the intimacy of the acute field-botanist in eastern America or in eastern Asia he would have realized his error.

Some other plants have less predictable mutations. Every experienced taxonomist knows one or more unresolvable puzzles in each of many large genera, plants like the *Cerastium arvense* or the *Campanula rotundifolia* complexes, in which several characters, pubescence, presence or absence of bloom or glandularity, shape, size and texture of foliage and size and shape of floral parts, seem to align themselves into scores of somewhat recognizable combinations without the natural geographic ranges or the stability over broad areas which we demand of true species and geographic varieties. These include jordanons, microspecies, biotypes, ecotypes, states, phases, forms and other biologically significant but taxonomically minor variations. Call them biotypes, ecotypes or what you will (the historically established usage of the taxonomist calls them *formae*), but do not call them species. That would indicate a confusion of ideas and a lack of understanding of long-established terminology.

To this group of highly variable organisms belong the domestic animals and plants which have proved economically most important to man. A rigidly stable species, not capable of modification under domestication, would be of little value on the farm. The stock-breeder and the plant-breeder must have plastic types with which to work. And so it happens, as Professor Goldschmidt so clearly emphasized at Chicago, that, to quote his words, "The majority of the geneticists' work is done with domestic animals and plants or with such wild forms as have given plenty of mutations under cultivation." I have never yet been asked by a geneticist to recommend to him for experimentation a fixed and unvarying species. It is not particularly satisfactory to seek for reactions from those who can not respond.

No matter how much or how little flowering plants may vary in habit and outward aspect, one final and

conclusive character is looked for by the conservative taxonomist. (I say conservative, for I can express only that view-point. When, as just happened, I pick up the latest issue of one of our American "Floras" and see two intergrading shrubs with identical foliage and fruit maintained as distinct species, with the perfectly frank statement, "Our two species . . . may be distinguished by habit alone," I find myself unable sympathetically to represent the view-point of *all* taxonomists.) If there is no appreciable modification of flowers or fruit, and especially of the seeds, the conservative student has learned to be cautious about separating species. If the flowers, fruits or seeds are fundamentally and constantly different, the plants are considered specifically separate, even though they may be superficially quite similar. As is, to quote the figures once used by Dr. Robinson at one of these meetings, the depth and impassability of the separating channels rather than their shallow breadth which is significant.

Hypoxis of the *Amaryllidaceae* is an ancient genus, with some of its species isolated in Australia, which was cut off from connection with the other continents early in the Cretaceous, the remainder in tropical and temperate southern Asia, Africa and tropical and temperate America. Superficially the plants are almost identical, but, borrowing the formula from another sphere of thought most used by the taxonomist, we find that in *Hypoxis*, as in many another genus, it is "by their fruits ye shall know them." The geographically isolated species of *Hypoxis* have seeds which are absolutely distinctive.

With *Hypoxis* in mind, as one of the thousands of genera with impassable deep channels separating its species, let us turn to more plastic types. Among the naturally plastic species in our wild flora few are more obvious in their responses to change of habitat than some of the amphibious plants. *Sagittaria cuneata* commonly fruits on muddy shores. There the adult and fertile plant develops slender petioles and arrow-shaped blades. In the seedling condition, however, the plant simulates the more primitive species of *Sagittaria* in having broad bladeless phyllodia, and only as it matures does it send up the slender-petioled aerial leaves. Let the seedlings develop under a deep current of water, where, at the normal fruiting season, they remain irretrievably drowned; then, failing to flower and fruit, the plant may, if it can reach the surface, develop one or two aerial blades, or, if the struggle to make the surface is futile, it will form nondescript structures half way between true blades and the primitive phyllodia. Such colonies, although never fruiting, will reproduce and spread, often over considerable areas, by means of subterranean stolons. Given conditions where muddy shores are always found, the fertile first type will prevail; given a deep current and no open muddy bank, the last type will regularly appear. They are not specifically nor even varietally distinct. Both can easily be grown from the same sowing of seed; but is it unreasonable to believe that by continuance of the isolation through countless generations these traits might be gradually intensified and eventually fixed? Man's life-time is far too short to witness such stabilization, but nature works in millions, not decades of years.

One of the commonest plants of shores and flooded meadows is the meadow parsnip, *Sium suave*. Starting growth under water in spring, its first foliage is finely dissected. As the stem elongates the leaflets become less divided and at flowering time no trace of the primary foliage is retained. Let the seeds fall into deep water, however, whence the seedlings can not emerge; the leaves will become filmy, the leaflets reduced and often pectinate. This aquatic phase, so completely unlike the terrestrial, fooled the earlier taxonomists. When it was first brought to his attention by Dr. Joseph Carson, Durand, with the moral support of Asa Gray, fell into the trap and described it as a new species, *Sium Carsonii*. Nowadays we know that seeds from a single plant will produce either extreme, according to where the seeds chance to fall.

Following this same species into another extreme habitat, the river estuary, where twice a day the fresh to brackish water covers and uncovers the flats with the movements of the tides, we find a plant of wholly different aspect, with the lateral leaflets undeveloped and the terminal leaflet greatly broadened. Although this estuary phase of *Sium suave* never fruits, it makes the gesture of flowering, and finally thickens the bases of the axillary fascicles of leaves, which, bulb-like, apparently serve for vegetative reproduction. Given a continuance of the estuary conditions through a long epoch, might not *Sium suave*, forma *fasciculatum* become as fixed as are the sterile *Polygonum viviparum*, *Saxifraga cernua* and other vegetatively propagating species of broad circumpolar range and unvarying reproduction by bulblets?

Another amphibious plant which all of you must know is the species of lake margins which has long passed as the European *Polygonum amphibium*. Whether we so treat it or whether we join Amos Eaton and his followers in calling it an American species, *Polygonum natans*, is here immaterial. The aquatic plant has close, cylindric sheaths, like cuffs, long and slender petioles and oblong, round-tipped leaf-blades. It is dominant at the margins of thousands and thousands of lakes and ponds. Years ago, the late C. Hart Wright discovered in swamps of western New York a very different plant, with broad,

horizontal collars or ruffs spreading from the summits of the sheaths and with subsessile and lance-acuminate blades. Asa Gray, to whom it was sent, at once described it as a remarkable new species, *Polygonum Hartwrightii*. Subsequent botanists by the hundred came to know this unique plant as an erect species of swamps, thickets and dryish meadows. Hardly a cedar swamp in northern Maine and the Maritime Provinces lacks it, and it might there be looked upon as a typical species. The "jolt" in this case came when a country store-keeper in a Connecticut village, the late Luman Andrews, found the common aquatic plant cast up by the waves on the dry shore and, forthwith, sending up from its axils typical branches of terrestrial *Polygonum Hartwrightii*. Subsequently, the observations of Luman Andrews have been many times corroborated, and *Polygonum Hartwrightii* as a distinct species has disappeared. If the specific criterion I at first emphasized had been applied, *Polygonum Hartwrightii* would never have been called a species. Its flowers and fruits are quite like those of the aquatic plant. On the other hand, in the thickets and swamps, which have resulted from the gradual drying out of former glacial lakes and pools, *Polygonum Hartwrightii* maintains itself. In the year 1,001,933, when these areas may have become even less subject to occasional inundation, may it not perhaps be eligible for inclusion in a list of true species?

Let me refer to one other amphibious plant, the marsh cinquefoil, *Potentilla palustris*. In early summer, when the water is high, this half-shrubby species sprawls by the river-margin or in the flooded meadow, and its glabrous, dark-green foliage colors broad areas. Later, however, when the drouth of midsummer has converted the meadow into a bed of dry tinder, something has happened to the dark-green marsh cinquefoil. New vegetative shoots have sprung up, covered with silvery-silky foliage. Just as in the stranded aquatic *Polygonum*, the new shoots with silvery foliage have sprung from individual plants of quite different aspect. I leave you to make your own deductions.

Turning from hydrophytes to one of our common xerophytes, almost every one knows the bearberry, *Arctostaphylos Uva-ursi*, which trails on arid sands or over sterile rocks of the northern half of the Northern Hemisphere. In May its really beautiful flowers expand, broadly urn-shaped and whitish, with pink lobes. At the tip of Cape Cod, in sandy pitch pine woods, a party of my students discovered one October beds of bearberry flowering profusely, but with brilliant carmine and very slender, barrel-shaped corollas. This red-flowered shrub, continuing to flower through November, would anywhere pass as a remarkable new species. But, alas, when spring comes the identical shrubs, still holding a few lingering, slender red flowers, come out with a profusion of the ordinary urceolate white corollas of everyday bearberry! Interpret the matter as you will, it is at least suggestive that the spring-flowering *Hamamelis vernalis* of the ancient Ozark Plateau and the vernal species of *Hamamelis* of the ancient flora of eastern Asia are represented throughout the more recently available area of the northeastern states and southeastern Canada by the autumn-flowering *Hamamelis virginiana*. Given a million years of undisturbed occurrence, with now and then successful fruiting, might not *Arctostaphylos Uva-ursi*, forma *heterochroma* eventually join *Hamamelis virginiana* as a finally established autumn-flowering species?

The few cases (to which I could make hundreds of additions) thus far discussed are by the careful taxonomist treated only as phases, states or forms, not even as varieties. They are individual variations of single plants. Now we will spend a few minutes on some geographic varieties, *i.e.*, variations which in distinctive or definable areas have become so thoroughly established as to be characteristic of the region.

Whereas individual plants of *Potentilla palustris* and likewise of *Potentilla Anserina, Dryas integrifolia* and many other species alter their pubescence with changes of moisture-content of the soil, and numerous other plants show parallel responses with increase or decrease of soil-alkalinity or -acidity, some others have stabilized their coats of trichomes over distinctive geographic areas. Thus, to continue with the plastic genus *Potentilla*, on the dry open gravels, sands and acid rocks of the Atlantic slope, *Potentilla canadensis* is a dominant plant, characterized by closely appressed silky pubescence, so insignificant as to appear merely as a slight sheen. On the ancient uplands of the Alleghenies and the Ozarks, regions which were the Cretaceous cradles of many plants whose descendants have migrated out to the areas formerly occupied by Cretaceous and Tertiary seas and Pleistocene ice, there occurs a plant identical in habit, foliage, flowers and fruit, but shaggy with long villous pubescence. Localized in two perfectly distinctive but adjacent ancient areas *Potentilla canadensis* var. *villosissima* is presumably the progenitor of the silky eastern plant which Linnaeus happened first to call *Potentilla canadensis*. The point I wish to emphasize, however, is that these two tendencies, which in many other plants occur merely as temporary fluctuations or mutations without appreciable geographic isolation, have in this case established a geographic separation. They are, consequently, geographic varieties (subspecies of some students). Hundreds of other quite parallel cases will occur to the experienced taxonomists, in *Potentilla, Fragaria, Astragalus, Panicum, Paspalum, Andropogon, Pteri-*

dium and almost any other plastic vascular genus. The extreme splitters, those who care not or know not whether a species rests on a sound basis of fundamental differences of the reproductive structures or whether it is merely a local trend with conspicuous but comparatively unimportant differences in the abundance and length of trichomes, stultify taxonomy, it seems to me, by undiscriminatingly treating such very minor tendencies as species, and they often actually so dignify even the mere tendencies or fluctuations which do not have a suggestion of geographic separation.

Every ten-year-old child who has had a garden knows, if he has any power of observation, that plants neglected and allowed to struggle in dried-out or sun-baked spots will have a minimum of foliage in comparison with the bulk of flowers. He also knows that individuals which grow in moister, richer or shadier situations have an excess of foliage and a minimum of flowers. When he has made that elementary deduction he has become an experimental biologist. Nature has been carrying on the same experiments on a larger scale. On the sunny meadows of our eastern states one of the joepye-weeds, *Eupatorium maculatum,* is abundant, with its broad crimson corymb clearly overtopping the reduced upper foliage. Proceed northward to the river-valleys of northern New England or the foggy coasts of Nova Scotia, the plants will be found to have larger leaves and reduced corymbs, until finally, in Newfoundland, eastern Quebec, northern Maine and the Lake Superior region the leaves so completely overtop the corymb as to mark the var. *foliosum.*

This foliose development characterizes geographic varieties of many species in the region of *Eupatorium maculatum,* var. *foliosum.* Explain them as you will, they are definitely variations which have gradually worked out a geographic or ecological segregation. But, without reproductive differences and with an abundant series of transitions, they have not yet become species. They are, however, very clearly on the way.

In the peats and damp sands of the Atlantic coastal plain one of the neatest, though insignificant, plants is *Bartonia paniculata,* found from Louisiana to Newfoundland. Throughout the South it is a consistent plant with small straw-green flowers with sharp sepals and petals. In southern New England and on Long Island, however, it becomes a little variable and in Nova Scotia this variation has become so stabilized as to rank as var. *intermedia.* On Sable Island, separated from Nova Scotia by 100 miles of sea and standing as a last unconquered remnant of the sunken coastal plain which, Professor Douglas Johnson assures us, went under approximately a million years ago (in late Pliocene or earliest Pleistocene), the species is represented only by var. *sabulonensis;* but on the mainland of Nova Scotia one can get every conceivable transition from typical *Bartonia paniculata* or from the northern var. *intermedia* to the variation which on Sable Island has become an unvarying extreme. Proceeding northward across Cape Breton, the flowers become larger and more corolloid and, finally, on Newfoundland we get everywhere the thoroughly constant and unvarying large-flowered var. *iodandra.* Considered by themselves the Newfoundland and the Sable Island plants would make consistent species, but so many transitions occur that we must admit that the million years since the foundering of the northern Coastal Plain has not sufficed to dispose of the embarrassing intergrading series.

One more case, which must be my last. *Epilobium,* as every one knows, has a silky and conspicuous coma on the seed, whence the book-name, willow herb. By the current treatments of the tribe the world-wide *Epilobium* is always generically distinguished by having the coma, while the western American *Boisduvallia* lacks it. A willow herb without a coma would not be a willow herb. Nevertheless, see what has happened! The commonest and most plastic species of North America is the wide-ranging *Epilobium glandulosum,* in some northern regions with the foliose development already noted, in some others with reduced upper foliage and change of leaf-outline. The varieties are very numerous, but they all have identical seeds, with smoothish deep-brown surfaces and long white coma.

If you go to the great tidal flats of the St. Lawrence you will see the finest development of estuary imaginable. For miles and miles from well up-river above Quebec far down-river toward the Gulf, at every low tide much of the flat margin of the bed of the St. Lawrence is exposed as a seemingly endless mud-flat, freely dotted with stranded fish-weirs. Twice a day, at the rapid rise of the tide, these vast mud-flats are deeply drowned by fresh to brackish water. Only a limited number of plants can stand these rapid changes, from complete submergence in water and burying in mud to alternating periods of boiling and broiling. But, singularly enough, *Epilobium,* with one of the most perfect adaptations for wind-dispersal in a dry atmosphere, has found the inundated flats and seems to like them. The plant of the drowned estuary in habit, foliage and flowers is inseparable from the commonest variety of *Epilobium glandulosum.* But of what use is wind-dispersal to a regularly inundated and mud-encrusted plant? Absolutely of no use. Consequently or at least (either way you view it), the estuary plant in its seeds is not an *Epilobium* at all. It is unique in the vast cosmopolitan genus in having no coma whatever, and

it has further departed, not only from the terrestrial *Epilobium glandulosum,* which it superficially closely simulates, but from all other species in eastern America by altering its seeds, so that, instead of being brown and only minutely pebbled, they are gray and covered with ridges of coarse papillae. Here, at last, nature has evolved a species, *Epilobium ecomosum.*

From a purely academic view-point it would be possible to argue that *Epilobium ecomosum* is the only surviving remnant of an ancient series of subaquatic plants which, taking to the land, have, all over the world, evolved the coma as an adaptation for wind-dispersal. But, compared with the great geological age of the habitats of some typical *Epilobia,* that of the estuary of the St. Lawrence, available only since at least the first Pleistocene invasion, is comparatively modern. Furthermore, did time permit, I should like to discuss from the same estuary of the St. Lawrence a beggar tick (*Bidens*) which has no awns, such as regularly characterize the terrestrial species of *Bidens* and supply the generic name. Of what use would awns be in such a habitat? On land they indiscriminately seize hold of the fur or the coats of every passing animal, but the fish of the lower St. Lawrence are too smooth to function as dispersal-agents, even for *Bidens.*

We may reason that in these and several other similar cases, one of the numerous predetermined variations of *Epilobium* or of *Bidens* or of some other genus fortuitously sprang into being in the estuary of the St. Lawrence and in this satisfactory environment has found opportunity to prosper, or we may prefer to view the peculiar environment itself, as so often seems to be the case, as molding an old species into something more fitted to the special surroundings. Whichever interpretation we choose, the simple fact remains that the field-botanist who would look successfully for thoroughly differentiated local species and pronounced geographic varieties (incipient species) has learned (as Charles Darwin did before him) to go to restricted areas which for ages have been ecologically or physiographically unique or which for at least a thousand millenniums have had remote or insular or peninsular isolation.

DEVELOPMENT OF OUR EARLY KNOWLEDGE CONCERNING MAGNIFICATION

By Professor **WILLIAM W. FORD**
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ANY clear transparent object with one convex surface and one flat surface or two convex surfaces acts as a magnifier, and the statement is often made that the use of such materials for magnification goes back many centuries. Thus large convex pieces of rock crystal were found by Layard in the ruins of a palace at Nimrud below the ancient city of Nineveh in Assyria. It is now agreed that such pieces of crystal could not have been used as lenses to enlarge the size of objects because of their uneven surfaces and bands, but that they probably served as ornaments to be worn on the chest. Various references to spectacles can be found in ancient Chinese writings, but such glasses were undoubtedly employed for the protection of the eyes and not as an aid to vision. A knowledge of the principle of magnification may be very old, however. Euclid in the third century B.C. investigated the laws of refraction, and Seneca apparently grasped the idea. In his "Questiones Naturales," written about 63 B.C., he states that "letters, however small and dim, are comparatively larger and distinct when seen through a glass globe filled with water." The appreciation of this principle is also closely associated with the manufacture of spectacles with the distinct purpose of improving the sight. These probably arose among the Venetian glass workers, and their discovery is usually attributed to Salvino d'Amarto degli Amarti of Florence and Allesandro della Spina of Pisa. The evidence for this is not entirely satisfactory. Cole[1] says that Francesco Redi (1626–1697), physician, naturalist, poet, mentions probably the first written reference to spectacles in a manuscript, dated 1289, written by a monk who says that he could neither read nor write without the glasses called *occhiali* for the improvement of his vision. Rolleston,[2] however, says that the "Lilium Medicinae" of Bernard de Gordon of Montpelier, published in 1305 or 1306, contains the first notice of spectacles.

How far back in history the use of simple lenses goes is equally doubtful. It has sometimes been claimed that ancient gems could not have been cut and fashioned into jewelry without an aid to the sight, and that engraved and illuminated texts required some magnification for their preparation.

[1] Cole, Ann. Med. Hist., viii: 4, 347–359, 1926.
[2] Rolleston, "Internal Medicine in Clio Medica," p. 35, 1930.

Locy[3] states that George Hoefnagel published in 1592 a set of fifty plates of insects engraved on copper. These pictures were drawn by his son Jacob, and some indicate the use of magnifying glasses. These plates of Hoefnagel are, as far as known, the earliest printed figures of magnified objects. The naturalist Mouffet also probably employed simple lenses (Locy[3]). His "Theater of Insects" (*Insectorum sive animalium minimorum theatrum*) was prepared in manuscript as early as 1590, but was not published till 1634. Some of the illustrations in this book show magnification.

All evidence of this character, tending to show rather indirectly that simple lenses must have been used at various early periods in the world's history, is of little importance. The real development of the knowledge of magnification came from the work of the mathematicians and the physicists, beginning with Euclid in the third century B.C. Ptolemy of Alexandria, about A.D. 153, in his mathematical and astronomical investigations probably was the first to study the laws of the refraction of light thoroughly. We owe our knowledge of the optical properties of curved mirrors primarily to the Arabian Alhazen or Al Haitham (Hasan ibn al Hasan ibn al Haitham, Abu Ali, 965–1038). Locy gives 1052 A. D. as the date of his manuscript. Simple lenses were familiar to Roger Bacon (1214–1294), who cleared up many of the laws of reflection and refraction of light and suggested their use for bettering the vision. He is indeed sometimes called the "Father of Microscopy." Leonardo da Vinci (1452–1519) also studied the optical properties of lenses and developed the camera obscura, Maurelico the mathematician (1494–1575) in his turn investigated them and Niblo of Poland made a very complete study of the refraction produced by air, water and glass.

Simple microscopes, *i.e.*, simple lenses attached to crude stands, were in all probability first described by Descartes in 1637 in his Dioptrique. This instrument had a magnifier and a concave mirror with the concavity towards the objects to be examined. In 1671 Athanasius Kircher, a Jesuit priest, made a crude simple microscope by attaching the object studied to a stage with a kind of rest. This instrument gave an enlargement of about 32 diameters, and Kircher was apparently the first individual to note the use of simple lenses for the study of living materials. He may also have had a kind of compound microscope with lenses made of small glass globules.

The greatest development of simple microscopes, and we even say their perfection, came at the hands of Antony (Antoni) van Leeuwenhoek of Delft (1632–1723). He was descended from a good Dutch family of brewers and at the age of 16 went to Amsterdam and became bookkeeper and cashier in a clothing establishment. He returned to Delft after a few years, married at the age of 22 and six years later took a minor office as "Chamberlain of the Sheriff" in the Delft Court. The position was that of a beadle and the pay amounted to £26 a year. This post Leeuwenhoek held for 39 years and the stipend continued to the end of his days.

Early in life Leeuwenhoek became interested in the manufacture of lenses, having observed that by grinding them with diamond dust he could greatly improve their usefulness. He preferred small ones of short focal distance, fastened them to various types of stages and manufactured a large number, owning 419 instruments, including 247 simple microscopes and 172 lenses set between pieces of metal. These lenses were all of glass, except three of quartz or rock crystal. Half of them were mounted in silver, three in gold. At Leeuwenhoek's death he bequeathed 26 simple microscopes, made from lenses ground by himself and set in silver, to the Royal Society of London. They were examined by Henry Baker and described by him in "The Microscope Made Easy" in 1742. He states that the lenses in these 26 microscopes were all of the double convex variety and not spheres or globules. Soon after Baker's description these instruments were lost sight of and they have never been recovered. An original Leeuwenhoek microscope now exists in the University of Utrecht.

Charles Singer[4] believes that the highest magnification obtained in Leeuwenhoek's microscopes was 160 diameters, and it varied from 40 to 133 diameters. It is interesting to note that the front lens of the modern oil immersion objective is practically the same in structure as Leeuwenhoek's simple lens. No one has ever seen as much as he did with simple microscopes, and soon after his work appeared compound instruments began to be improved and offered greater optical advantages to the scientist. The simple microscope has survived, however, as the hand lens of the physician and the dissecting microscope of the laboratory. It is not without interest that Charles Darwin took one with him on the voyage of the *Beagle* in 1832.

The empirical discovery of the compound microscope is ultimately bound up with the discovery of the telescope, and there are three claimants to the honors. Singer states that these are Zacharias Jansen, Jan Lippershey and James Metius, also known as Jacob Adrianzoon. The date of the discovery of the microscope may be placed between 1591 and 1608.

[3] Locy, "Growth of Biology," p. 199, 1925.

[4] Singer, "Steps Leading to the Invention of the First Optical Apparatus," in "Studies in the History and Method of Science," Vol. II, p. 385, 1921.

By this time both convex and concave lenses were well known and constantly used in the manufacture of spectacles. Zacharias Jansen (1580–16—?) was the son of a spectacle maker of Middleburg, Holland, and by accident discovered that if he put two lenses in a tube they increased the size of objects. This instrument was perhaps provided with two convex lenses, the lower one having a short focal length to look at near objects. Such an instrument was called a flea-glass or fly-glass, because it was employed to examine small objects like fleas or flies.

The claim of Jan Lippershey to the honor of the discovery of the telescope rests primarily upon the Acts of the States-General preserved in the Government Archives at the Hague. Here it is stated that on October 2, 1608, the Assembly of the States considered the petition of Jan Lippershey, a spectacle maker, native of Wesel and a resident of Middleburg, who had invented an instrument for seeing at a distance. He was subsequently employed to manufacture three of his instruments from rock crystal. Singer[5] believes that these were provided with convex objectives and concave eyepieces and did not invert the image. In the same month James Metius of Alkomar also petitioned the Assembly of the States for the exclusive right to sell an instrument of his invention to make distant objects appear larger and more distinct. This James Metius was the son of Adrian Metius, burgomaster of Alkomar in 1573. He also accidentally put two lenses together in a tube and found that he could see distant objects. The instruments of Lippershey and Metius were called spy-glasses, and their military importance called attention to their usefulness.

The Jansens began to manufacture both types of instruments, flea-glasses or fly-glasses (microscopes) and spy-glasses (telescopes) in the early part of the seventeenth century. According to the testimony of William Boreel (1591–1668), Dutch ambassador to France, given in a letter to Pierre Borel (1620–1671) the Jansens presented one of their instruments, probably the telescope, to Prince Maurice, the governor and supreme commander of the United Dutch forces. They also gave a microscope to the Austrian Archduke Albert, supreme governor of Holland. Afterwards, in 1619, when Boreel was ambassador to England, Cornelius Drebbel showed him this instrument which the archduke had presented to Drebbel, who was a mathematician. Drebbel himself began to manufacture microscopes in 1621.

The scientific discoverer of the telescope was Galileo (1564–1642), but some doubt still exists as to his relationship to the discovery of the microscope. In 1609 he heard a rumor of the invention by a Dutchman of an instrument by means of which a distant object could be made to appear distinct and near. Immediately he made use of his knowledge of the laws of refraction to construct a similar instrument along exact lines. He fastened two lenses at the ends of a leaden tube, one plano-concave, one plano-convex. Looking through the concave eyepiece he observed that objects seen were three times nearer and nine times larger than when observed with the naked eye. He rapidly improved the construction of the instruments, getting one through which objects were a thousand times greater and thirty-fold nearer than if observed by the unaided vision. Examples of Galileo's telescopes are still in existence, preserved in the Galileo Museum in Florence. It should be noted that the principle of the telescope is to have an objective which focuses at infinity (or far objects). As to Galileo's discovery of the microscope, *i.e.*, an optical instrument for seeing near objects magnified, our knowledge of his contributions is somewhat casual. John Wodderborn, a Scotch student who attended Galileo's lectures at Padua, stated in 1610 (see Fahie[6]) that he had often heard Galileo describe the employment of an instrument for the examination of insects, and similar evidence is given by the Frenchman, Jean Tarde (Fahie[7]). There is also some reason to believe that Galileo presented a microscope to the King of Poland in 1612. As stated above, Cornelius Drebbel began to manufacture microscopes in 1621 and Jacob Kuffler, a relative of Drebbel, brought such an instrument to Rome as a present from Nicholas Fabri de Peirese of Paris (1580–1637) to one of the cardinals. Two years later two others arrived. One of them was constructed of two lenses, and nobody in Rome could understand its use. At that time Galileo came to Rome, and on being shown the apparatus stated that he himself had previously made such instruments "which magnified things as much as 50,000 times, so that one sees a fly as large as a hen." He soon made some instruments showing objects erect and not inverted. These were called fly-glasses, *occhiale*, later *occhialino*. Unfortunately, we have no satisfactory knowledge of the construction of the fly-glasses. Two relics of them are in the Tribuna di Galileo, Florence, but the lenses are missing and there is some doubt as to the genuineness of the tubes.

The term "microscope" was introduced by Giovanni Faber in a letter of April 26, 1625, to the Academy

[5] Singer, *ibid.*, p. 408.

[6] Fahie, "The Scientific Works of Galileo (1564–1642)" in "Studies in the History and Method of Science," Vol. II, p. 206, 1921.

[7] Fahie, *ibid.*, p. 229.

of the Lincei and was applied to the instrument constructed by Galileo to look at small things and called by him *occhiale*. The lyceum also gave the name "telescope" to a similar instrument of Galileo's, but designed to look at objects at a distance.

Galileo's explanation of the path of light in the bilenticular system is usually regarded as unsatisfactory but was improved by Kepler (1571–1630) in his Dioptrice (Cologne 1611). Kepler suggested the construction of both telescopes and microscopes with two convex lenses, the theoretical forerunners of our modern instruments. Actually the manufacture of microscopes has followed in general the lines laid down by the Jansens. Instruments began to be made in considerable quantity in Holland by the middle of the seventeenth century. Fontana in 1646 improved the Jansen microscope by substituting a positive eyepiece for the negative, *i.e.*, one with the real image of the objective below all the lenses of the ocular, rather than with the real image between these lenses, and thus getting a magnification much greater than that obtained by the Jansens. This type of microscope evidently remained in use for some years, for Otto Fredrik Müller (1730–1784) used an instrument designed by the Jansens and improved by Fontana. It is said to have given a magnification of over 300 diameters. This increase of magnification over that given by Leeuwenhoek's best instruments, about 160 diameters, marked the doom of the simple microscope, certainly for the study of bacteria, and since then the chief efforts of physicists have been devoted to improving compound microscopes. Other types have been invented from time to time, among which may be mentioned those of Hooke (1665), Bonnani (1697) and Divini, who exhibited a kind of compound microscope before the Royal Society in 1668. To Hooke the credit of adding the field piece to the ocular is sometimes given. Huygens in 1660 was familiar with the field piece, however, for he manufactured negative oculars with the real image below the field piece and above the other lenses in the ocular. He used a plano-convex field piece and a plano-convex eyepiece, both convexities facing downward.

The chief difficulty in microscopes lies in the chromatic aberration. As lenses of shorter focal distance (less than 1 inch) and more nearly spherical are employed, the obliquity of the rays so greatly increases the aberration that false colors are introduced, and definition becomes defective. The limitation of the size of the aperture to keep down the chromatic aberration shuts out the light and makes the field too dark for successful vision. A similar difficulty arises with the telescope. The first achromatic telescope was probably made by Chester Moor Hall of Essex, England, in 1733. Hall combined lenses of different refracting indices and made a telescope which gave a vision of objects free from color. In 1759 Dollond, on the basis of Swedish investigations on the dispersion of refracted light, made a telescope with lenses of different kinds of glass with respect to the divergence of color. His object glasses gave almost complete correction of the chromatic aberration; later the spherical aberration was corrected by the same means.

Not until the early part of the nineteenth century, however, was this principle applied to the construction of microscopes. In 1812 Amici of Modena made the first attempt at an achromatization of the objectives along the lines marked out by Dollond. The chromatic aberration of the objectives was corrected by a combination of plano-convex lenses of flint glass with biconvex lenses of crown glass. He also employed a highly curved plano-convex front lens with a numerical aperture of 105. The spherical aberration was done away with by a combination of convex and concave surfaces of different curvatures. In 1830 Lister (the father of Lord Lister) worked out another principle for the correction of aberration by having the image point of one lens coincide with the object point of another and a few microscopes have been made with this design. Selligues and Chevalier of Paris superimposed three or four combinations, each of double convex lenses of crown glass cemented to plano-convex lenses of flint. By 1837 excellent microscopes were available, giving a high magnification and a clear definition. Amici discovered the principle of water immersion lenses and Andrew Ross in 1839 invented a collar adjustment for them. The water lens was greatly improved by Hartnack in 1855. The first microscopist to employ oil instead of water was apparently Wenham, who demonstrated the use of cedar oil before the Royal Microscopical Society in June, 1870.

A little later Stephenson in 1878 also employed the principle of oil immersion for lenses and at his suggestion Abbe manufactured the first effective immersion lens in which cedar oil was utilized. About this time a number of improvements in the construction of microscopes were made, chiefly by Abbe, who profited greatly by Helmholz's investigations on the undulatory nature of light. In 1886 he made an apochromatic objective in which the secondary spectrum was not noticeable and the spherical aberration corrected for three colors. This was used with a compensating ocular of Jena glass. Abbe also introduced the substage condenser which goes by his name, the final improvement in the construction of microscopes which has given us our modern high-powered instruments of such wonderful utility and beauty.

OBITUARY

EDWARD M. SHEPARD

1854–1934

THE death of Edward Martin Shepard at Springfield, Missouri, on April 28, ended an active and useful life that any one might envy. Born at Winsted, Connecticut, on May 15, 1854, and graduated from Williams College with the degree of master of arts in 1878, after a year as professor of natural science at Waynesburg College, he came to Drury College at Springfield in 1879 as professor of biology and geology. For thirty years, until his retirement in 1909, he was a member of the faculty, librarian during the early years, acting president for one year and dean for a time. He built up a strong department of geology, organized a museum, later named in his honor, with his personal collections as a basis, and established the Bradley Geological Field Station at Graydon Springs.

Dr. Shepard's original interest was botany, and he was a student of Daniel C. Eaton, famous authority upon the ferns of North America. He came to Missouri with the intention of applying himself to study of mosses and hepatics, those obscure bryophytes so plentiful in the hills of New England. The Ozarks, he found, were disappointingly deficient in these plants, and his interest turned to other subjects. He was one of numerous men trained in botanical science who have made geology their life work.

For this science he found the Ozarks with their varied conditions an almost untouched field, and he devoted his life to their study. He was active in organizing the Missouri State Geological Board, of which he was a member throughout its existence, except for one term. One of its reports by his pen is an exhaustive volume devoted to the geology of Greene County. He was engaged also in investigations for the United States Geological Survey, and made a detailed study of the New Madrid earthquake area. Upon the geology of southern Missouri he was recognized as an authority, and his activities extended far beyond that field. He was consulting geologist for mining companies in many western states and in Mexico. Travel in foreign countries gave him a broad general acquaintance with geological phenomena in remote parts of the earth.

Dr. Shepard's interests were not confined to geology. He was active in civic matters and in the social life of his city. Among his hobbies were the history of the Ozarks, about which he had a unique fund of information, and the archeology of the Ozarks and of Mexico. Although born far away in New England, in an altogether different environment, he was intensely loyal to the Ozarks and had a sympathetic understanding of their mountain people.

While to the general public he was known best for his contributions to geological knowledge, it is probable that Dr. Shepard's richest contribution consisted in what he imparted to the students who came in contact with him during thirty years in the lecture room. Among them are a number who have distinguished themselves in geology and other branches of science. Their success was a matter of great pride and satisfaction to him.

Few scientists, unfortunately, are born teachers, but Edward Shepard was one of those, and fortunate were his students. Of greatest significance, perhaps, was the fact that he possessed a broadness of sympathy and a tolerance such as too seldom exist among faculty members of a small college with the peculiar limitations that usually surround it. With his broad vision, based upon travel and wide reading and association, and doubtless even more as a result of his own natural talents unconsciously used, he had an extraordinary faculty for presenting his subjects in an attractive manner. Indifferent, indeed, was the student whom he could not arouse with his almost childish enthusiasm for investigating every phase of natural history. His breadth of knowledge and experience were matters of inspiration for students whose own experiences were limited by the environs of a small Missouri city as it existed thirty years ago, when the writer had the privilege of being one of his students.

It is as a leader of geological field trips for his students that I best remember him. He was the most active and by far the most alert of the party, eager to discover something new, and to point out every significant object. After a long, hard day in a horse-drawn vehicle, he always seemed untired at evening, and was always a kindly host, versatile enough to prepare some special dish for the table, read aloud from a favorite book, describe his experiences in foreign lands or in the Ozark hills, or repeat one of the stories of which he had a well-assorted supply.

Dr. Shepard is survived by his wife, Harriett Elma Ohlen, whom he married in 1881, and a daughter, Isabelle Shepard. His greatest grief was the death of his only son, Edward M. Shepard, Jr., at the beginning of a career that seemed full of promise.

Few men have the fortune to live so rich and gracious a life, and to possess so many friends. Geological science was enriched by his discoveries and his lucid interpretation of their significance. All over the United States and in foreign lands are hundreds of Dr. Shepard's students and acquaintances whose lives have been made happier and more useful because of their association with him.

PAUL C. STANDLEY
FIELD MUSEUM OF NATURAL HISTORY

SCIENTIFIC EVENTS

THE ASSOCIATION OF GERMAN MEN OF SCIENCE AND PHYSICIANS

THE Berlin correspondent of the *Journal* of the American Medical Association gives the following account of the reorganization of the Association of German Men of Science and Physicians:

The Versammlungen Deutscher Naturforscher und Aerzte, as it has existed for more than a generation, has adopted a new order of business and a new constitution. The object of the new organization is to oppose the splitting up of medicine and the natural sciences into various specialties. It is proposed to emphasize the problems in which all (or at least many) branches of natural science and medicine have a common interest. At the same time, the traditional task of the society must not be forgotten; namely, to give the public an insight into the growth of German science.

The general assembly will be held only once in two years, which will necessitate using great care in the choice of topics and in applying sharp criticism to the subject-matter to be presented. The scientific section as such will cover three and one half days at the most. The board of trustees will henceforth organize only general sessions, sessions of the main scientific and medical groups, and joint sessions of several branches but no sessions of single branches. In addition, there will be evening lectures on popular scientific subjects. The topics for all sessions will be decided on by the officers of the society after consultation with the "scientific committee" and, as far as possible, with the large scientific societies representing individual specialties. In the general sessions and the sessions of the main group, scientific questions will be discussed that have either reached a reasonably definite settlement or that present a high degree of general interest. As speakers, such investigators will be chosen as have shown special merit in the fields concerned. In the opinion of the officers of the society, a general discussion, the course of which no one can foresee, would weaken the force of these communications and lessen the effect on the world's scientific circles; hence all discussion will be reserved for the so-called joint sessions, which will deal with topics that are of interest to the representatives of at least several of the branches of natural science or medicine and that will be presented by several speakers in the form of concise papers, to be followed by a detailed thorough discussion. In these sessions particularly the principle of combining several problems of common interest will come to the fore.

The officers of the society will not organize any professional meetings for the discussion of topics pertaining to a single branch of science or medicine. It is expressly stated that there is no place in the Versammlungen Deutscher Naturforscher und Aerzte for those persons who have no interest in anything outside their own specialty. Furthermore, no "unofficial" sessions of representatives of specialists will be allowed to disturb or take time away from the regular program as announced. Affiliated societies representing specialists will, however, be permitted to hold sessions in the convention city immediately before or immediately after the regular sessions.

The endeavors of the aforementioned society to emphasize the solidarity of the natural sciences and the medical sciences will likewise be furthered by the Zweckverband der Deutschen naturwissenschaftlichen und medizinischen Kongresse. The declared objective of this league is to create sentiment that will make for a broader organization of congresses of specialists. The propaganda will be confined to a publicity campaign and will not include any attempts to exert an immediate influence on the several societies of specialists. It is hoped that, in this manner, greater coherence will be injected into the organization of German scientific congresses as a whole.

PROGRAM OF THE NATIONAL FOREST RESERVATION COMMISSION

THE National Forest Reservation Commission has announced the approval of a program of expanding by more than 3,000,000 acres the national forest purchase units on the headwaters of the Tennessee River in the Southern Appalachian area. The commission also approved the immediate purchase of 762,186 acres of forest lands in 45 national forest purchase units in states east of the Great Plains, these lands to come at once under the protection and administration of the Forest Service. In addition, the commission approved a new land exchange plan between the Forest Service and the State Conservation Commission of Michigan involving the future development of both state and national forests.

A new national forest purchase unit to which approval was given is situated in the southwestern corner of Virginia, comprising a gross area of 658,000 acres in the upper drainage of the Clinch River, a tributary of the Tennessee. It is to be called the Clinch Unit. Four other large units lying in Tennessee, North Carolina and Georgia will be added to the existing Unaka, Nantahala, Cherokee and Pisgah National Forests.

Acquisition of the new units, nearly doubling the areas of national forests in the Southern Appalachians, will enable the Forest Service and cooperating agencies to consolidate fire protection, to combat excessive erosion in many portions of the Tennessee drainage, and to put thousands of acres of forests in better productive condition to sustain the economic interests of the people.

Rehabilitation of the new national forest areas, it is expected, will help reduce the occurrence of disastrous floods that have resulted from the removal of timber and the farming of steep mountain slopes, and will furnish continuous and even streamflow for

the benefit of hydro-electric development and for municipal and community water supply.

The gross extent of the new purchase areas approved is 3,227,000 acres, but only about 2,326,000 acres have been classed as purchasable, since the wooded lands are interspersed with many small fertile valleys and farms, and developed areas which will not be purchased.

The new areas are largely mountainous and formerly were covered with vast forests of mountain hardwood, usually mixed with pine and hemlock. In some areas there are stands of spruce. A few small patches of virgin timber remain. Larger lumbering operations in the region have been followed in many places by small portable mills, and in most instances not much attention has been paid to forest reproduction. Fires have ravaged the lands and seriously damaged the young growth.

Industries that can be aided by the protection and development of timber stands in the region include pulp and paper mills, wood-using factories of various kinds, rayon mills and other factories depending more or less upon the forest products.

Purchases in the new unit and the current additions as approved will be made with a portion of the $20,000,000 allotted from Emergency Conservation Work funds by President Roosevelt last summer for the purchase of lands for the national forests in the East as an emergency relief measure. Acquisition in the new areas will be subject to the same policy as in areas previously established by the commission and will not be given prior status. That is, the remaining unexpended portion of the fund will be apportioned for use among all the units established in the East.

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY

THE Cold Spring Harbor Symposia on Quantitative Biology will be continued at the Biological Laboratory this year during July with a consideration of some aspects of growth. It will be recalled that the conference-symposia were inaugurated last year as a further method of fostering a closer relationship between biology and the basic sciences, mathematics, physics and chemistry. Representatives of these sciences are invited to join with biologists during July in the discussion of some aspect of biological research.

A small number of participants are in residence throughout the whole month, or an appreciable part of it, while others are invited to present papers and take part in discussions without being in continuous residence at Cold Spring Harbor.

The former this year include: George L. Clark, chemistry, University of Illinois; Charles B. Davenport, genetics, Department of Genetics, Carnegie Institution of Washington; M. Demerec, genetics, Department of Genetics, Carnegie Institution of Washington; Hugo Fricke, biophysics, The Biological Laboratory; Hans Mueller, physics, Massachusetts Institute of Technology; Otto Rahn, bacteriology, Cornell University; Nicolas Rashevsky, physiology, University of Chicago; Victor C. Twitty, embryology, Stanford University; Harold C. Urey, chemistry, Columbia University.

Participants not in continuous residence include: W. T. Astbury, textile physics, The University, Leeds (paper to be read by Dr. Clark); Felix Bernstein, mathematical statistics, Columbia University; H. W. Chalkley, physiology, National Institute of Health, Washington; J. W. Gowen, biology, Rockefeller Institute, Princeton; F. Gudernatsch, biology, New York University; F. S. Hammett, physiological chemistry, Research Institute, Lankenau Hospital; Theo. L. Jahn, biology, Yale University; L. G. Longsworth, physical chemistry, Rockefeller Institute for Medical Research; Charles Packard, zoology, Columbia University; Oscar W. Richards, biology, Yale University; Charles R. Stockard, anatomy, Cornell Medical College; C. Voegtlin, pharmacology, National Institute of Health, Washington; C. P. Winsor, physiology, Harvard University; Sewall Wright, zoology, University of Chicago; Ralph W. G. Wyckoff, biophysics, Rockefeller Institute for Medical Research.

The building up of the discussion on the aspects of growth under consideration this year will probably be of interest both from the point of view of the method in general and of this year's conference-symposia in particular.

The physical background is supplied by discussions of the following aspects by the men indicated: the structure of liquids and solids, Mueller; the principles of crystal growth, Clark; ultra-violet photography as a means of studying crystal growth and cell structure, Wyckoff; x-ray studies of protein structure, Astbury; the chemical-physical foundation of the biological activities of x-rays, Fricke; the effects of x-radiation upon cell growth and structure, Clark; diffusion in cell models and volume changes analogous to growth, Longsworth; possible uses of heavy water in the study of biological phenomena, Urey.

Physico-mathematical aspects of cellular multiplication and development will be discussed by Rashevsky, mathematical analysis of growth of mixed population, by Winsor, and a critique of curves of growth and of relative growth will be given by Davenport.

The chemistry of growth receives considerable attention in the following: building materials and energy, and the growth mechanism, both by Rahn; natural chemical factors in growth and development, Hammett; observations concerning the chemistry of cell growth and division, Voegtlin and Chalkley, and

specific chemical factors influencing vertebrate growth and differentiation, Gudernatsch.

The genetics of growth is to be considered particularly in discussion of the gene in relation to growth and development, Demerec; internal constitution and genic factors in growth determination, Stockard; the gene as a factor in pathology, Gowen, and the genetics of abnormal growth in the guinea pig, Wright.

Other specific biological aspects of growth are to be discussed: growth and structure of plant tissues with special reference to cellulose, Clark; growth correlations in amphibia studied by the method of transplantation, Twitty; mitogenetic rays, Rahn; growth of yeast, Richards, and population growth in protozoa, Jahn.

Certain biological aspects (biological dosimeters) of x-radiation in growth and in other phenomena will be considered by Packard. Bernstein will discuss growth and decay generally, and Rahn the chemistry of death.

Such, in practise, is this year's development of the more formal part of Cold Spring Harbor conference-symposia on quantitative biology. Investigators interested in taking part in the discussion may obtain programs from the Biological Laboratory at Cold Spring Harbor.

HONORARY DEGREES AT YALE UNIVERSITY

TWELVE honorary degrees were conferred by Yale University at the two hundred and thirty-third commencement. These included the doctorate of laws, conferred on President Roosevelt, on Dr. William Lyon Phelps and on Dr. James Bryant Conant, and the doctorate of science conferred on Dr. Frederick George Keyes and Dr. Adolf Meyer. The degree of master of science was conferred on John Levi Rice, formerly of New Haven, now commissioner of health of New York City.

The candidates were cited by Professor Phelps and the degrees were conferred by President Angell.

The citations made in conferring the degrees on President Conant, Professor Keyes and Professor Adolf Meyer were as follows:

JAMES BRYANT CONANT, LL.D.

Professor Phelps:

President of Harvard.

Born in Dorchester, Massachusetts, March 26, 1893, Dr. Conant took his B.A. at Harvard in 1913, Phi Beta Kappa and his doctor's degree in 1916. He began to teach there the same year, and proceeded through the grades of instructor, assistant professor, associate professor, to the professorship of organic chemistry in 1927. He was the head of that department until he became head of the university. His researches in chemistry were recognized everywhere by those competent to judge; in 1932 he received the Chandler Medal from Columbia University and in the same year the Nichols Medal from the American Chemical Society. In 1924 he was visiting lecturer at the University of California and in 1927 research associate of the California Institute of Technology at Pasadena.

But although learned specialists are proud of his distinction as a scientific investigator, the world is not particularly interested in that. When at the age of forty, he was elected president of Harvard, every one who did not have the privilege of his acquaintance wanted to know what kind of a man he was.

Well, serious students who took his courses, and those who were not serious took something else, found him not only an admirable teacher, but an intimate associate. He spent much time with individual students, and seemed to understand both them and their problems. That is to say, he was interested both in the subject and in the object. In matters requiring practical judgment and executive ability, his qualities have been admired by his associates for a long time.

One can not help thinking of the election to the presidency of Harvard of another young professor of chemistry, in 1869. It is the universal wish that President Conant may have as long a time in office as his scientific predecessor enjoyed; that such length of service will again be of great service to Harvard and to the cause of education everywhere, is the universal belief.

His own words on taking office may fitly be quoted today: "May I have skill and patience to continue the bold advance, and courage and steadfastness sufficient for my duty in these uncertain times. . . . I pledge my entire strength and devotion to the leadership of this community of scholars and students, that knowledge and understanding may be increased and transmitted to the youth of our country."

We know that both scholarship and citizenship are safe in his hands. During his entire career he made only one mistake, and that is now about to be rectified.

President Angell:

Eminent chemist, foregoing a brilliant scientific career to heed the imperative call to leadership of the most venerable of American universities, Yale manifests her profound confidence in your future achievement and her filial respect and admiration for the noble institution whose destinies now lie so largely in your hands by conferring upon you her highest honor, the degree of Doctor of Laws, admitting you to all its rights and privileges.

FREDERICK GEORGE KEYES, SC.D.

Professor Phelps:

Physical chemist. Born in Kingston, Canada, he took his bachelor of science degree at Rhode Island College, and his master's and doctor's degrees at Brown University. He is professor of physical chemistry research at the Massachusetts Institute of Technology, chairman of the department of chemistry and director of the George Eastman Research Laboratory. He is to-day the most prominent American investigator in the field of thermodynamics. His particular contribution is the interpretation of the thermodynamic properties of gases and liquids from the point of view of intramolecular forces

and the introduction of specific and characteristic magnitudes in the physico-chemical applications of the theory of Josiah Willard Gibbs.

He has developed new methods for measuring the physical properties of fluids; as a practical result of his work, enormous savings of fuel in improved steam-turbines have been made; while similar benefits to refrigeration practise have come from his work in ammonia. It is clear, therefore, that he is not a Laodicaean.

His mastery of the methods of theoretical analysis is equalled by his skill in devising and carrying out experimental procedures of the highest precision.

President Angell:

Nature has joined in you fruitful and unusual powers of theoretical analysis to high fertility in ingenious practical experimentation, the union issuing in a plethora of discoveries invaluable to man. In recognition of your honorable achievement and because she sees in you a worthy descendant in the direct scientific line from her own great Willard Gibbs, she confers upon you the degree of Doctor of Science, admitting you to all its rights and privileges.

ADOLF MEYER, SC.D.

Professor Phelps:

Psychiatrist and neurologist. He is a man, who, although he was born in the nineteenth century, belongs emphatically to the twentieth.

He was born near Zurich, in Switzerland, and studied there until he took the degree of doctor of medicine in 1892. Then he pursued his studies—often overtaking them—in Paris, Edinburgh, London, Vienna and Berlin. Later he was on the teaching staff of various American universities, going from his professorship in the Medical School of Cornell, to Johns Hopkins in 1910. This came about through the presentation by Doctor Welch of Clifford Beers's book, "A Mind that Found Itself," to Mr. Henry Phipps, who then founded the Phipps Psychiatric Clinic in Baltimore. Psychiatry had not been an unknown plant in that educational Eden, but it seemed exotic, delicate and unattractive. Several years elapsed before Meyer's clinic was ready, but his activities in the field of the study of the central nervous system and his technique, seemed to his contemporaries not only superior but miraculous.

When the institute came, it was abreast of every other clinical field in its facilities for research.

Dr. Meyer's broad viewpoint, involving the biological, the psychological, and the social approaches to behavior, his keen understanding of the importance of the analysis of average or normal behavior, and of the importance of preventive measures in psychiatry, have made him a leader.

Absorbed in his work, he failed to realize his own importance. When the Queen of Belgium visited his clinic in Baltimore and found he was busy, she waited awhile; then seeing him at a distance, walked over and introduced herself as the Queen of Belgium. He replied, "Yes. How long have you thought you were the Queen? Many of my patients have similar ideas."

President Angell:

Beloved physician to the ailing mind of man, armed with all the weapons of science and twice armed by a gentle, kind and sympathetic spirit, you have brought hundreds from the edge of the precipice back to happy, normal lives. In no small measure through your influence, psychiatry and mental hygiene have won their way into the high places of American medicine, whence so long and so unwisely they had been excluded. Yale University counts it a pleasure to confer upon you the degree of Doctor of Science, admitting you to all its rights and privileges.

SCIENTIFIC NOTES AND NEWS

PROFESSOR BAILEY WILLIS, emeritus professor of geology at Stanford University, was elected at the Berkeley meeting president of the Pacific Division of the American Association for the Advancement of Science. He succeeds Dr. Joel H. Hildebrand, professor of chemistry at the University of California.

THE honorary degrees conferred by Harvard University at its two hundred and ninety-eighth commencement included the degree of doctor of science conferred on Dr. Thomas Hunt Morgan, director of the William G. Kerckhoff Laboratories of the California Institute of Technology, and the degree of doctor of laws conferred on Dr. Edward Lee Thorndike, professor of psychology and director of the division of psychology of the Institute of Educational Research at Teachers College, Columbia University. The citations made by President Conant were: "Thomas Hunt Morgan—a renowned zoologist whose experimental skill and penetrating insight have laid bare the mechanism of heredity." "Edward Lee Thorndike—educational psychologist, the foremost American pioneer in developing those new types of measurement which supplement our oldest forms of examination."

PRINCETON UNIVERSITY has conferred the degree of doctor of laws on Dr. James Bryant Conant, president of Harvard University, and the doctorate of science on Dr. Arthur Holly Compton, Swift professor of physics at the University of Chicago.

WILLIAMS COLLEGE conferred at commencement the degree of doctor of science on Dr. Winterton C. Curtis, professor of zoology at the University of Missouri.

DARTMOUTH COLLEGE on June 11 conferred the degree of doctor of science on John Adam Fleming, acting director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

AT the sixtieth commencement of Carleton College on June 11 the degree of doctor of science was conferred on Dr. Edward C. Rosenow, and the degree of doctor of laws on Dr. Donald Church Balfour. Dr. Rosenow is head of the Division of Experimental Bacteriology at the Mayo Clinic and Dr. Balfour is head of the Division of Surgery and president of the Board of Governors.

DR. LAWRENCE J. HENDERSON, professor of biological chemistry at Harvard University, received on May 12 the degree of doctor *honoris causa* from the University of Grenoble.

THE University of Oxford conferred on June 24 the doctorate of science on Dr. Archibald Vivian Hill, Foulerton research professor of the Royal Society.

DR. WALTHER NERNST, professor of physical chemistry and director of the Institute of Physics at the University of Berlin, celebrated his seventieth birthday on June 25.

THE council of the Royal Society of Arts, London, has awarded the Albert Medal for 1934 to Sir Frederick Gowland Hopkins, president of the Royal Society and Sir William Dunn, professor of biochemistry at the University of Cambridge, for his researches in biochemistry and the constituents of foods.

THE first award of the British Gold Medal for aeronautics has been made to Captain G. de Havilland for his services tending towards advancement in the science of aeronautics.

KING GEORGE has approved the grant of the Polar Medal in bronze, with clasp inscribed "Antarctic 1929–31," to Dr. William W. Ingram, who was a member of the British, Australian and New Zealand Antarctic Research Expedition, 1929–31.

PROFESSOR PIETRO RONDONI, of the department of pathology at the University of Milan, was recently named "academician of Italy." Professor Rondoni is known for his researches in morphology and serology.

DR. B. E. LIVINGSTON, of the Johns Hopkins University, has been elected president, and Dr. J. P. Bennett, of the University of California, vice-president of the American Society of Plant Physiologists for 1934–35. Dr. A. E. Murneek, of the University of Missouri, will serve another year as secretary-treasurer.

AT the tenth annual meeting of the American Association of the History of Medicine, held at Cleveland, on June 11, the following officers were elected: *President,* Dr. E. B. Krumbhaar; *Vice-presidents,* Drs. C. N. B. Camac and W. S. Middleton; *Secretary-Treasurer,* Dr. E. J. G. Beardsley, Philadelphia, and Dr. C. V. Weller, incoming member of the council.

DR. J. C. MEAKINS, professor of medicine at McGill University, was chosen president-elect of the Canadian Medical Association at the recent meeting held at Calgary, Alberta.

DR. FRANK A. HARTMAN, professor of physiology at the University of Buffalo, has been appointed professor of physiology at the Ohio State University.

DR. RAYMOND B. ALLEN, associate director of the New York Post-Graduate Medical School, becomes associate dean of the Columbia School of Medicine on July 1.

DR. WILLIAM WELCH FLEXNER, of Bryn Mawr College, son of Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, has been appointed assistant professor of mathematics at Cornell University.

CAPTAIN G. T. R. HILL has been appointed to the Kennedy chair of engineering in the University of London.

DR. HENRY COHEN, lecturer in medicine in the University of Liverpool and honorary physician to the Liverpool Royal Infirmary, has become professor of medicine in the university in succession to Professor John Hay.

DR. CURTIS FLETCHER MARBUT, chief of the Soil Survey of the U. S. Department of Agriculture, although past the usual retirement age, will be among the scientific men who are retained in the service of the government during the fiscal year of 1935 because of the need for continuing exceptionally important contributions to their respective fields of scientific research. The appointment of Dr. Marbut as honorary professor of soils at the University of Missouri will not be affected by his continuance as chief of the Soil Survey of the Bureau of Chemistry and Soils.

DR. WILLIS R. WHITNEY, vice-president of the General Electric Company, has been appointed chairman of the education committee of the Board of Trustees of Union College.

DR. LEROY P. ABRAMS, who, following the retirement of Professor George J. Peirce, was appointed head of the department of botany at Stanford University, has become director of the Natural History Museum, which has been reorganized as an administrative unit.

DR. E. L. COREY, assistant professor of physiology at the University of Virginia, will work during the summer at the Morris Biological Farm of the Wistar Institute.

PROFESSOR A. A. ALLEN, of Cornell University, left on May 28, for Churchill, Manitoba, on Hudson Bay, for six weeks' intensive study of the northern grouse

or ptarmigan. He is making the trip in the interests of the American Game Association as well as of the laboratory of ornithology at Cornell, and has the active cooperation of the New York State Conservation Department and the game officials of the Dominion of Canada.

DR. SAMUEL N. DICKEN, of the department of geography of the University of Minnesota, will make a study this summer of typical village life in the Sierra Madre Oriental of northeastern Mexico, and Dr. Ralph H. Brown, assistant professor of geography, will continue his work on the types of farming and community life in the foothills of the Big Horn mountains near Buffalo, Wyoming. The work has been made possible by funds provided by the Rockefeller Foundation through the Graduate School.

DR. A. RICHARD BLISS, JR., director of the Reelfoot Lake Biological Station, Tennessee, delivered the commencement address on June 1, at the eighty-fourth annual commencement of the Cincinnati College of Pharmacy.

PROFESSOR JULIUS TANDLER, of the National College of Medicine, Shanghai, and of the University of Vienna, lectured at the University and Bellevue Hospital Medical College on "The Principles of Abdominal and Pelvic Anatomy" on June 18 and 19.

Nature reports that the thirty-ninth annual congress of the South-Eastern Union of Scientific Societies will be held at the University of Reading from July 11 to 14, under the presidency of Professor H. L. Hawkins, professor of geology in the university. On July 11, Professor Hawkins will deliver his presidential address entitled "Fossils and Men." The presidents of sections will deliver the following addresses during the congress: T. D. Kendrick (Archeology), "The Art and Archeology of the Early Anglo-Saxons"; Dr. Macgregor Skene (Botany), "Some Problems of Germination"; Dr. C. B. Williams (Zoology), "Insect Immigration in Great Britain"; T. H. Edmunds (Geology), "The Water Supply and Geology of the South-East of England"; C. H. Grinling (Regional Survey), "Surrey for Action." On July 13, Professor E. B. Poulton will deliver a public lecture entitled "The Power of Changing Color as a Form of Protective Resemblance."

BY the will of Mrs. Abbey K. Babcock, her estate is left in trust to her husband, Frederick K. Babcock. On his death the Field Museum, Chicago, will receive $100,000, and the residue of the estate is bequeathed to regents of the University of Michigan to promote "urological medical research work and the study and dissemination of urological diseases."

A GRANT of $3,000 has been made by the National Research Council to the School of Physiology in the department of medicine in the University of Virginia to carry forward a research in the relations of the adrenal glands and sex, by Dr. Sydney W. Britton, professor of physiology.

AT the recent commencement exercises of Cornell University, Dr. Livingston Farrand announced that during the year the university had received two bequests, one of $500,000, representing the maturity of a trust fund which Mr. Westinghouse established in 1925 and from which he received the income until he died. The second bequest, amounting to $250,000, left by C. Sidney Shepard, a Yale graduate and a trustee of Cornell for thirty-two years, will be added to the permanent endowment of the university as the Sidney and Elizabeth D. Shepard Fund, in honor of Mr. Shepard's parents. A gift of $100,000, from the General Education Board, was also announced. It will be used for the operating expenses of the New York Hospital-Cornell Medical College in New York City.

ANNOUNCEMENT is made of grants amounting to $8,500 annually for two years to the School of Medicine, Western Reserve University, for the extension of work in experimental pathology. Of this amount, $3,000 annually has been contributed by Nathan G. Richman and Charles L. Richman, of Cleveland, and $500 annually by Richard H. Kohn; while the remaining $5,000 comes through Nathan L. Dauby and Morton J. May, trustees of a Charity Trust created by Commodore Louis D. Beaumont, now residing abroad. These sums will be employed for the prosecution of further work by Dr. Harry Goldblatt, now associate professor of pathology, and his assistants, especially on the study of high blood pressure and of peritonitis. These and other investigations of the same general nature will be carried on at the Institute of Pathology.

THE twenty-third annual report of the Brooklyn Botanic Garden, recently published, records a total attendance for 1933 of 1,315,847, as against 1,307,964 in 1932. Reports on research in progress occupy twenty-one pages. Four research students were registered at the garden during the year. The number of lectures, addresses and class exercises was 1,684. Twenty-one exhibits were installed, not including those at the garden. For the exhibit at the 1933 International Flower Show in New York, the garden received the Gold Medal of the Garden Club of America. During the year, forty-two garden clubs and similar groups held meetings at the garden. Twenty-seven talks on botanical and horticultural topics were broadcast over several different stations. More than 6,000 teacher-

requests for study material for colleges, high schools and elementary schools were met with material for the instruction of nearly 260,000 pupils. The Local Flora Section, of about three acres, was opened on May 9. This area is planted on an ecological basis. The total budget of $165,690 represented a decrease of income of $22,782 as compared with 1932, a loss of approximately 12 per cent. The loss of available income as compared with 1930 was $46,873. During the year the sum of $10,232 was added to the endowment fund. The year was closed without a deficit and without vacating any positions.

DISCUSSION

A RARE SPECIMEN OF ZEA MAYS VAR. SACCHARATA[1]

A SPECIMEN of maize, collected by Earl H. Morris, archeologist, and identified by the writer as *Zea Mays var. saccharata,* is of special interest because of the fact that it is the only specimen of sweet corn so far identified from the numerous historic collections of corn recovered in the United States. This specimen is found in the American Museum of Natural History. Through the courtesy of the curator in chief, Dr. Clark Wissler, the writer secured the loan of this specimen for determination and study and it is described as follows:

Zea Mays var. saccharata
Aztec sweet corn
Specimen No. 29–0–9397

Length of ear 3.75 inches, diameter 1 inch at butt, tapering. Eight-rowed, regular. Kernels broad and shallow, measuring 5/8 of an inch broad, 2/8 of an inch long, cuneate to truncate, central area distinctly depressed, forming a marginal ridge, pericarp coarsely wrinkled, color pale amber, endosperm translucent, hard and brittle. Embryo completely disintegrated, color dark brown. Starch grains small, many poorly formed and tending to aggregate. Cob buff color. Ear enclosed in a husk 7¼ inches long, shank 2¼ inches long bearing 5 nodes. The kernels are homozygous throughout and possess the severe wrinkling and translucent horny endosperm typical of sweet corn. The size, color and 8-rowed character are highly suggestive of Golden Bantam, a popular present-day variety.

The question has been raised as to the possibility of this being an immature specimen of field corn. The condition of the kernels in the upper half of the ear give evidence that the ear was plucked while still immature. The kernels towards the base of the ear are fully developed and show the wrinkled pericarp and translucent endosperm typical of sweet corn.

The specimen was collected by Mr. Earl H. Morris, who furnished the writer the following statement regarding its history.[2]

The ear of sweet corn from Room 139 of the Aztec Ruin, New Mexico, came from a refuse deposit laid down during the Mesa Verde phase of Pueblo III. The Aztec Ruin was built between 1110 and 1121 by a group of Chaco people, occupied for a time, then abandoned, and finally reoccupied by groups representative of the Mesa Verde strain of Pueblo culture. In accordance with Dr. Douglass' findings, the entire San Juan country was abandoned not long before or after 1300 A. D. In view of these facts it would be safe to estimate that the ear of corn in question was grown between the years 1200 and 1300.

The fact that sweet corn existed in pre-Columbian times is proved by this specimen. Since it is the only historic specimen so far identified in the numerous archeological collections of maize, doubt is expressed as to sweet corn being either a wide-spread or an important Indian food plant in the United States in the pre-Columbian period. The theory of its origin as a mutant of field corn is in harmony with the genetics of the corn plant.

The fact may also be noted that, among the numerous collections of historic corn from Peru, apparently but one specimen of sweet corn has so far been identified. This specimen was collected by M. Uhle under the direction of Dr. A. L. Kroeber, of the University of California, to whom we are indebted for the loan of this ear. This specimen, termed Huamachuco corn of the Inca period from northern Peru, was identified by Hendry[3] as sweet corn, a determination with which we do not wholly agree. This specimen we think belongs to the starchy sweet corn *Zea amylsaccharata* of Sturtevant. The starchy character of the endosperm is much more pronounced than in the pseudo starchy sweet corn of Jones. At any rate, it is interesting to note that sweet corn material is apparently rare in the maize collections from Peru, which seems to run parallel to the situation in the United States.

A. T. ERWIN

IOWA STATE COLLEGE

A CONCEPT OF COLLOIDAL SYSTEMS BASED ON PROBABILITY

THE two most important features upon which the nature of the colloidal state is generally predicated

[1] Journal Paper No. J 146 of the Iowa Agricultural Experiment Station, Ames, Iowa.

[2] Earl H. Morris, letter to author under date of November 20, 1933.

[3] Huamachuco corn by Hendry. *Jour. Amer. Soc. of Agron.*, vol. 22, 1930.

are the size and surface of the colloidal particle. This state is further characterized by the postulate of heterogeneity, which is a general, almost metaphysical hypothesis that the particle in the colloidal state is different from the medium in which it is dispersed.

Most formal definitions of colloids, or the colloidal state, are dependent on the concept of size of the particle. It has been pointed out that many reactions of colloids are not amenable to stoichiometric interpretations. The clear-cut proportionality between reactants usually prevalent in molecularly dispersed systems is almost entirely absent in colloids. Another difference between colloidal and crystalloidal systems is the ready reproducibility of the latter and the difficult reproducibility of the former when tested by the known indices.

The writer proposes a concept of the colloidal state based on a general probability hypothesis. A brief exposition is given below. An aqueous solution of sodium chloride is an example of a crystalloidal system. If one considers a hollow unit cube of 10 Å side length and moves this cube a distance of at least 10 Å, the probability is unity that the composition of this second cube is the same as that of the first cube. In fact, the composition of any cube of 10 Å side length is the same throughout the whole solution. So one may say that in an aqueous solution of sodium chloride one deals with a homogeneous system, homogeneous with respect to a unit cube of 10 Å side length. Theoretically, it is possible to choose a unit cube so small that moving it a distance equal to the length of a side of the cube gives a cube of different composition.

On the other hand, if one considers a colloidal system, such as a platinum hydrosol, the situation is different. It has long been known that the composition of platinum sols is complex. Pennycuick assigns them the general formula: $\chi Pt\ yPtO_2\ zPt(OH)_6H_2$. If one takes a unit cube of 10 Å dimension in a platinum sol and moves it a distance of 10 Å through the hydrosol, the probability of encountering a cube of similar composition is no longer unity, as was the case in crystalloidal sodium chloride solution. What the probability of finding a cube of similar composition is, is not known. It would be dependent on the history of the sol. The size of the unit cube chosen depends on the colloid under consideration.

A characteristic of colloidal systems which has been used to distinguish them from crystalloidal systems is the tendency of the former to change. The concept of probability can be applied in the following manner. Referring again to the system of aqueous sodium chloride, one sees that equilibrium is established almost instantaneously on dissolving the dry sodium chloride in water. Further, once equilibrium is established there is no tendency for the system to change in composition. In other words, the probability of change is practically zero. In contradistinction, a platinum sol is undergoing a slow, gradual change. Interpreted in the light of the above concept, a colloidal system is one in which the probability of change is greater than in a crystalloidal system. Changes due to the addition of electrolyte or those due to temperature and pressure are not considered. One deals with closed systems in which the tendency to change is a function of time. In equilibria of this nature probability can serve as a measure of this tendency to change.

The writer offers the above concept simply as a philosophical approach to colloids and not as an experimental index of distinguishing them from crystalloids.

M. MATTIKOW

BROOKLYN, N. Y.

THE SMALL LINEAR UNITS

IN SCIENCE, Vol. 79, No. 2043, page 184, Dr. J. F. McClendon comments as follows:

> A more serious error is often made in the conception of the micro-meter, which is a millionth of a meter and not a thousandth of a millimeter. A micro-meter is abbreviated μ, and the micro-micro-meter μμ. Many persons imagine that a micro-meter is a thousandth of a millimeter and suppose that a micro-micro-meter is a thousandth of a micro-meter, whereas it is a millionth of a micro-meter.

Dr. McClendon's argument seems to be based on the assumption that the prefix "micro" means millionth, whereas the Greek μικρός merely indicates small, little, trivial. It is true that science repeatedly uses the prefix to mean millionth, and in this specific case the argument is supported by many standard reference books. The "Handbook of Physics and Chemistry" (eighteenth edition, page 1630) gives, "Micro-micron (μμ) 1×10^{-12} meter." Other items in the same table show clearly the consistency of this notation.

On the other hand, Professor Manne Siegbahn, of the University of Uppsala, discussing "Spectroscopy" in the fourteenth edition of the Encyclopoedia Britannica (Vol. 21, page 183) mentions the "micron (μ), which is one-thousandth of a millimetre." In Webster's New International Dictionary (page 1337) under "measure" may be found "micron 0.001 mm" and "micromillimeter, micromil, 0.000001 mm." Again, on page 2548, under "Arbitrary Signs Used in Writing and Printing, VII, Miscellaneous," "μ micron, μμ thousandth of a micron." Many textbook writers have adopted this notation. See Grimsehl: "A Text-book of Physics," Vol. III, page 646;

Spinney, "A Text-book of Physics" fourth edition, page 611; Foley, "College Physics," page 666.

The final definition for such terms is determined by popular usage. These small units are rapidly entering the vocabulary of the public. Dr. McClendon's correction should be accepted. Delay will cause further confusion. It should be easy for every one to adopt the symbols, m – meter, mm – millimeter = 0.001 m = 10^{-3}m, μ – micron = 0.000001 m = 0.001 mm = 10^{-6}m, mμ – millimicron = 0.001 μ = 10^{-9}m, $\mu\mu$ – micromicron = 0.000001 μ = 10^{-12}m.

GLEN W. WARNER

THE RETURN OF MUSCULAR ACTIVITY AFTER PARALYSIS

SEVEN years ago I had a stroke of paralysis, affecting the right leg and arm and causing very slight confusion in enunciation. Among interesting features in recovery has been the effect of effort of will in the beginnings of muscular movement. These observations were made upon the earliest movements of the right hand, chiefly the thumb and fingers.

As indication of the location of the slight clot or leakage of blood in the brain, it might be well to say that the leg, at first completely dead to movement, returned to activity within a month sufficiently to allow walking, though it is not yet strong. Rapid repetition of the same consonant sounds was difficult and still is. The arm has recovered good use, except for some of the shoulder muscles which raise the arm. Raising the arm is still done partly by muscles which raise the shoulder and not, as is normal, by muscles of the arm proper, lying between shoulder and hand. In the hand the fourth and fifth fingers are weak, thumb, first and second fingers being in sharp contrast, showing nearly normal strength, though tiring with continued effort.

The point which seems of interest is the effect of volition in instigation of the beginnings of movement in the fingers, especially the thumb, and also rotary fore-arm movements. Lying upon the back, it was found within a couple of weeks that the fore-arm, when elevated at right angles to the bed and supported on the elbow, could be balanced by slight use of the arm and fore-arm muscles. Then experimentation began upon two points. Letting the fore-arm start to tip in any direction, it could be held from falling and made to tip in a different direction and held again. Successive tipping and stopping soon gave a jerky, rotating motion. Continuing in this way from day to day, it was but a week or so until pretty good rotary movement was possible. By that time the whole arm could be elevated at right angles to the bed with its weight chiefly on the shoulder, and it could be rotated.

But seemingly of more interest were the experiments upon thumb and finger motions and the part played by effort of the will. With fore-arm elevated, weight upon elbow, it was found that by *extreme* and prolonged effort of the will, an effort harder than any I had ever known before, an effort in which it seemed as if I were sweating blood but which didn't even moisten the forehead with perspiration, the thumb could be induced to bend perceptibly toward the fingers. At first it was only a bare trace of motion, and the exhaustion from the effort was so great that it could not be prolonged to produce more motion. After some minutes of recuperation a second violent effort of will succeeded in inducing another motion. In the experimentation it was seen that the initial periods of violent effort of will became shorter and shorter and the instigated motions gradually greater. This was true of the experiments on a single day and was also discernibly true in comparing results of successive days' experiments, though there was a slipping back between the last experiments one day and the first of the next day. The effort was as extreme as possible each time, but the duration of the extreme effort required to instigate motion grew less between the experiments of a single day, and on the next day the period of necessary initial effort was at first much longer than in the later experiments of the previous day, though perceptibly shorter than in the first experiments on that day.

It seemed that there was a threshold of resistance which had to be overcome and that this threshold lessened in needed duration in successive trials on any one day and, as experimentation went on, it lessened from day to day. During a few days the violence of the effort of will was extreme, but gradually the necessary violence diminished, and the effort needed in the later trials of one day became less than in the first one of that day. After some days both the violence and the length of time needed to instigate motion decreased until they became negligible.

After motion of the thumb was pretty well conquered, efforts to flex the fingers showed similar phenomena of necessary violent exercise of will and delay in its effectiveness, and gradual progress, as in the case of the thumb.

These phenomena seem to present something of interest and significance psychologically. I will not attempt to discuss them, except to say that the demonstration of the effect of the mental upon the physical seems to give reason for pause to some who are inclined to place all emphasis upon the physical and deny effectual action of the personal (spiritual) upon the physical.

I see no indication that ultimate recovery was at all hastened by any of this experimentation.

MAYNARD M. METCALF

WABAN, MASS.

SOCIETIES AND MEETINGS

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE thirty-third annual meeting of the North Carolina Academy of Science was held at the University of North Carolina, Chapel Hill, N. C., on May 4 and 5, 1934. About 220 members and visitors attended the meeting. Seventy-three papers and six exhibits were on the program. (Abstracts of most of these papers and some complete papers will appear at an early date in the *Journal of the Elisha Mitchell Scientific Society*). An outstanding feature of the exhibits was a beautiful and instructive wild flower show, under the direction of Dr. H. R. Totten, of the department of botany of the University of North Carolina.

The greater part of the first day was set aside for the presentation of papers before the General Section of the academy, and this was followed by the annual business meeting. In the evening the retiring president, Dr. B. W. Wells, professor of botany at the North Carolina State College, gave the presidential address on "Galls and 'Galls'." During the forenoon of the second day, the academy met in the following sections: General Section, Chemistry Section, Mathematics Section and Physics Section.

Resolutions of respect were passed in honor of three deceased members: Dr. James Munsie Bell, dean of the school of applied sciences of the University of North Carolina; Dr. William Battle Cobb, chairman of the division of soils of the North Carolina State College; and Dr. Francis Preston Venable, professor emeritus in the department of chemistry of the University of North Carolina.

The academy elected to life membership Dr. Collier Cobb, professor emeritus of geology at the University of North Carolina. The executive committee reported the election of twenty-two new members during the year and the reinstatement of six former members.

In the high school science essay contest, Mr. Miles C. Horton, of the Richard J. Reynolds High School, Winston-Salem, won first prize for his essay entitled "The Romance of Radium." (Essays for 1934 were confined to chemistry and physics.) The prize was a splendid set of books on scientific subjects.

The officers elected for 1934 were:

GENERAL ACADEMY

President, H. R. Totten, University of North Carolina; *Vice-president,* P. M. Ginnings, Greensboro College; *Secretary-Treasurer,* H. L. Blomquist, Duke University; *Executive Committee*—the above officers, Charles M. Heck, North Carolina State College, E. T. Browne, University of North Carolina and W. E. Speas, Wake Forest College; *Representative to the American Association for the Advancement of Science,* C. F. Korstian, Duke University.

CHEMISTRY SECTION

Chairman, J. H. Saylor, Duke University; *Vice-chairman,* R. W. Bost, University of North Carolina; *Secretary-Treasurer,* W. C. Vosburgh, Duke University; *Councillor,* Robert Neville Isbell, Wake Forest College; *Executive Committee*—the officers, F. W. Sherwood, North Carolina Experiment Station, and H. D. Crockford, University of North Carolina.

MATHEMATICS SECTION

Chairman, E. R. C. Miles, Duke University; *Secretary,* W. N. Mebane, Jr., Davidson College.

PHYSICS SECTION

Chairman, Calvin N. Warfield, Woman's College of the University of North Carolina; *Secretary,* J. S. Mears, North Carolina State College.

The thirty-fourth annual meeting of the North Carolina Academy of Science will be held at the Woman's College of the University of North Carolina, Greensboro, North Carolina, in 1935.

H. L. BLOMQUIST,
Secretary

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE sixteenth annual meeting of the New Hampshire Academy of Science was held at the Hancock Hotel, Hancock, New Hampshire, on Friday and Saturday, June 1 and 2.

The meeting was called to order on Friday at 7:45 P. M. by President Samuel P. Hunt. Addresses were given by Mr. Salvatore Pagliuca, of the Mt. Washington Observatory, on "Observations and Experiments on Mt. Washington"; by Dr. Henry I. Baldwin, of the State Forestry Department, on "Natural Grafting in Forest Trees"; and by Dr. George Woodbury on "A Prehistoric Tribe of the Texas Coast."

Papers by members were read on Saturday morning. On Saturday afternoon, following the business meeting, Mr. Hunt gave the presidential address, "Electric Service and its Cost," after which the remainder of the papers by members were read.

The following officers were elected for 1934–35:

President, Professor Harold A. Iddles, University of New Hampshire; *Vice-President,* Mr. Albert L. Clough, Manchester; *Secretary-Treasurer,* Professor George W. White, University of New Hampshire; *Member of Council,* Mr. Samuel P. Hunt, Manchester; *Councillor to American Association for the Advancement of Science,* Professor Walter C. O'Kane, University of New Hampshire.

GEORGE W. WHITE,
Secretary-Treasurer

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PHOTO-ELECTRIC COLORIMETER

THE principle of this simple apparatus is the following: In a blackened, covered wooden box a small rectangular glass jar (Fig. 1: 3), containing the fluid to be tested, is placed between an electric bulb (15 watts) (Fig. 1: 1) and a photoelectric exposure-meter

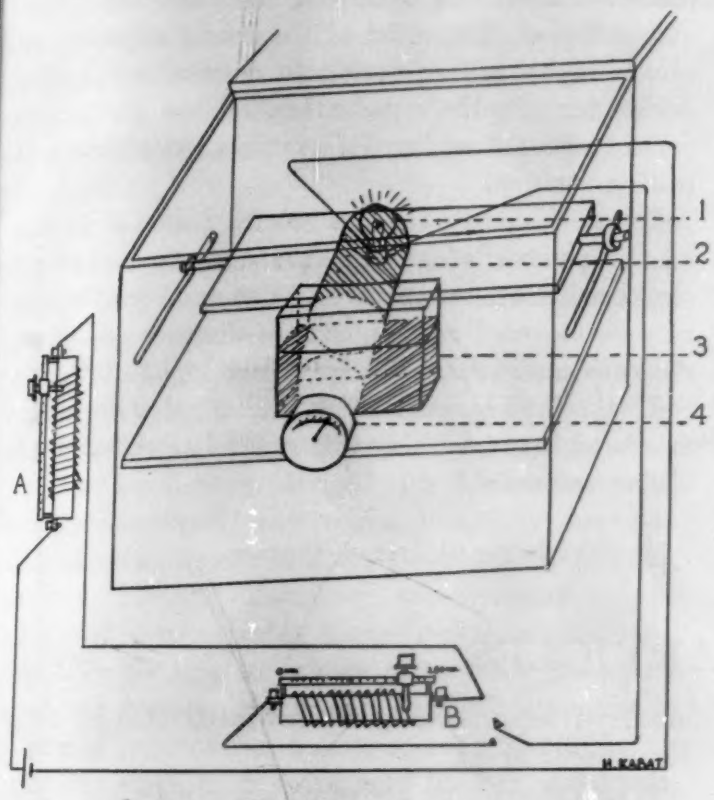

FIG. 1.

(metrophot or other devices) (Fig. 1: 4). A blackened metal tube (Fig. 1: 2) is mounted together with the bulb on a wooden board, which can be moved forward and backward in order to be adapted to the thickness of different jars. The electric bulb is lightened by the house-current (110 volts d. c.), which is led through two rheostats, the one, A, of 50 ohms and 5 amperes, the second, B, of 345 ohms and 1.1 amp. The current is interrupted by a switch. The slider-rod of rheostat B is subdivided into millimeters. If the current is closed, the light will operate the exposure-meter and the pointer will move to the right, the more, the darker the solution to be tested. Next, the slider of rheostat B is moved until the pointer of the exposure-meter reaches a given point (*e.g.*, 3). The distance in millimeters between the right edge of the slider and the zero point of the slider-rod scale corresponds to a given concentration of the color to be tested and which is found on a prepared table.

To give an example for the calibration of such a table, the determination of phosphorus with the help of the Fiske and Subarrow's method will be described for concentrations of 0.80 mg to 0.40 mg phosphorus per 100 cc. After removal of the glass jar, the slider B is moved to zero, and the slider of rheostat A is adjusted until the pointer of the meter reaches a middle position (*e.g.*, 15). Before each use the apparatus is adjusted to this fixed point, thus compensating the variations of the house-current. Next the glass jar is filled with a solution of mono-potassium phosphate to which the reagents of the test had been added and which contains 0.80 mg P per 100 cc. The cover of the box is closed. Five minutes after the mixture of the different reagents the electric current is shut, the slider of rheostat B is moved to the right outer end (280 mm), and the position of the meter pointer is noticed (*e.g.*, 3). Next, the solution is replaced by one containing 0.75 mg P per 100 cc, and the slider of rheostat B is moved until the meter-pointer again reaches the position of the first test (3). Then the millimeter distance between the right edge of the slider and the zero-point of the slider-rod is noticed (*e.g.*, 253 mm). The experiment is repeated at intervals of 0.05 mg P per 100 cc until a concentration of 0.40 mg P has been tested. Next the millimeter distance between each experiment is divided by 5 and thus a table is obtained which gives the comparative values for solutions differing in 0.01 mg P per 100 cc.

In order to test an unknown solution, the phosphorus content of which is between 0.8 and 0.4 mg per 100 cc, it is filled into the glass jar, after rheostat A has been adjusted. The cover is closed and the slider of rheostat B is moved until the meter-pointer reaches 3. The distance of the slider from the zero point of the rod is noticed and compared with the most closely corresponding figure on the prepared table. Immediately the phosphorus content of the solution in mg per 100 cc will be obtained. Tables for other ranges of concentrations may be obtained in a similar way. The measurements of the different parts are: Wooden box, 20 × 23 × 40 cm; glass jar, 27 × 50 × 53 mm (outer measurements); metal tube diameter, 40 mm, length, 45 mm. The price is approximately between $25 and $50, according to the type of exposure-meter which is used.

ARTHUR WEIL

NORTHWESTERN UNIVERSITY

A SIMPLE ERGOGRAPH

WE have had occasion to construct and use a simple hand ergograph which may be of interest to others because of the several advantages it offers. It is readily adjustable both as to size of grip and resisting force. Its construction is such as to promote a steady even pull throughout the operating stroke. It has been found more satisfactory for our research than other ergographs. At the same time it is sufficiently

inexpensive and easy to construct to make it suitable for classroom work.

The apparatus consists chiefly of an air pump (A)

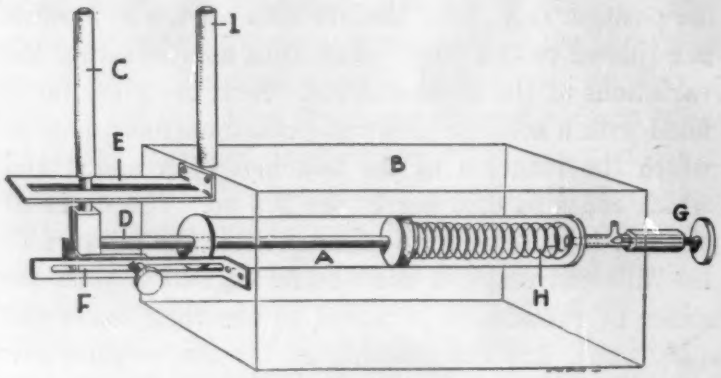

FIG. 1.

of the type used for inflating football bladders. This pump is mounted horizontally in a wooden box (B), each end of the pump being flush with the outside surface of each end of the box. A vertical metal rod (C) runs in a slotted guide (E), its excursion being limited by the adjustable stop (F). To the outlet nozzle of the pump is attached a needle valve (G). A coil spring (H) of suitable strength and an upright rod (I), attached to the box, complete the apparatus.

To operate the apparatus the forearm rests on the top of the box and the rubber (tubing) covered rods are grasped in the hand, the size of the grip being adjusted with the stop (F). When the grip is exerted, air is forced out of the pump through the needle valve (G) the adjustment of which controls the resistance to be overcome and therefore the required force. The outlet of the needle valve may be connected by rubber tubing to a suitable recording device for graphic registration. When the grip is relaxed, the coil spring (H) returns the piston to its resting position.

The work done may be calculated from the product of the number of strokes, the distance moved per stroke and the force required. The number of strokes may be recorded or counted; the distance moved per stroke is measured. The force required to bring the rod (C) into apposition with the rod (I) can be measured by performing that operation with a simple spring balance.

SAMUEL SOSKIN

MICHAEL REESE HOSPITAL, CHICAGO

SPECIAL ARTICLES

ACTIVE IMMUNIZATION IN MONKEYS AGAINST POLIOMYELITIS WITH GERMICIDALLY INACTIVATED VIRUS[1]

IN my previous work it was shown that sub-infective doses of active virus or virus-serum[2] combinations[3] may produce immunity against the virus of poliomyelitis. The former method, however, is attended by the danger of giving the disease during the course of immunization, whereas the latter method entails considerable difficulty in reaching the proper virus-serum combination. An excess of virus in the mixture may produce the disease, while an excess of serum reduces the immunity considerably.

Although the use of germicidally inactivated virus for the production of active immunity has been reported successful in the virus conditions, such as Borna disease, cattle plague, dog distemper, foot-and-mouth disease, fowl plague, herpes, psittacosis, rabies and yellow fever, the experimental results in the case of poliomyelitis, up to the present, have been both contradictory and indefinite.

Therefore, an attempt was made to produce active immunity against poliomyelitis in *Macacus rhesus* monkeys, using as antigen virus inactivated by either formalin or phenol.

It was shown that active poliomyelitis virus inactivated with formalin is antigenic. Virus treated with phenol did not prove as effective as formalized virus; besides, the concentration necessary to render the virus non-infective made it too irritating for convenient use. The monkeys were injected intracutaneously with a 10 per cent. virus suspension. Either one or two inoculations were given. In the latter case, the interval between the two doses was from 10 to 20 days.

The optimum antigenic dose was determined as being approximately ½ gram of cord tissue. This was based upon the results of the following experiments.

Tissue immunity was shown by only one of three monkeys which had received 2.5 cc of a 10 per cent suspension. One of these three had had one inoculation and the others, each two injections. Poliomyelitis antibodies were found in all three serums. Some tissue immunity was demonstrable in ten monkeys of a series of twelve animals, 3 of which were given one inoculation consisting of 5 cc of a 10 per cent. suspension and 9, two such inoculations. In seven of the ten, which showed tissue immunity, the degree of immunity was comparable with that of animals given similar treatment with active virus. Virus neutralizing substances were found in all their serums.

[1] This research was aided by grants from the New York Foundation and the Rockefeller Foundation.

[2] M. Brodie, *Proc. Soc. Exp. Biol. and Med.*, 30: 1238, 1933; *Jour. of Immun.*, in press.

[3] M. Brodie and A. Goldbloom, *Jour. of Exp. Med.*, 53: 885, 1931; M. Brodie, *idem.*, 56: 493, 1932.

Three of eleven animals received one 10 cc dose; the remaining 8 were given two such doses. Of the entire group, nine showed some tissue immunity, which is evidenced by the animals' resistance to direct intracerebral inoculation of active virus. Unlike those receiving 5 cc amounts, the tissue immunity of these animals was lower than that of monkeys receiving similar doses of active virus. Too, the degree of immunity was lower than that developed by the animals in the foregoing series of twelve animals. Nine of the eleven had humoral antibodies.

Comparing formalized non-infective virus with active virus, as to antigenic value, the following facts were derived:

(1) In the case of active virus, the dose and the subsequent degree of immunity were directly proportional. Using formalized virus, however, the optimum dose was found to be 5 cc.

(2) With formalized cord tissue, the humoral immunity was usually better than the tissue immunity, but decidedly lower than that developed when active virus was used, even though with 5 cc amounts of formalized antigen, the tissue immunity obtained using either antigen was quite comparable. In some instances, humoral immunity was present in the absence of demonstrable tissue resistance and *vice versa*. To be able to say definitely that there is a correlation between tissue and humoral immunity in the case of active virus, but no such correlation using formalized virus, more work must be carried out concerning the relationship between neutralizing substances in the serum (humoral immunity) and resistance to direct intracerebral inoculation (tissue immunity) of virus. Toward this end, and also to determine whether a non-specific neutralizing substance destroyed by formalin was present in the nerve substance, two monkeys received some non-virus-containing-tissue intracutaneously. Neither of the two developed any antiviral substances.

(3) Using active virus, two inoculations given 10 to 20 days apart were more efficient than one inoculation, but with inactivated virus this did not seem so.

A comparison between the immunity produced due to the injection of inactivated virus and that of convalescent monkeys showed that, using the inactivated antigen, the tissue immunity was sometimes about equal to, but that the humoral immunity was lower than, the corresponding immunities in the case of recovered animals.

The inactivated antigens used in this work produced no reaction whatsoever upon combined inoculations of large doses both intracerebrally and intraperitoneally; for neither temperature increase nor cerebro-spinal fluid pleocytosis were demonstrable. Whether immunity developed from either a killed or highly attenuated antigen can not be definitely stated. If immunity was due to a small quantity of residual virus or to virus of very low virulence, then one must suppose that the stimulation brought about by less than one intracerebral infective dose gave immunity. However, since less than 120 intracerebral infective doses of active virus produced no demonstrable immunity, it is not likely that immunity was due to a subinfective quantity of virus.

To further investigate this possibility, a series of 8 animals were given, intracutaneously, formalized virus suspension of sufficient infectivity to produce only a mild reaction upon combined intracerebral and intraperitoneal inoculation. Though still viable, the virus failed to give better immunity than did virus rendered non-infective. This again argues against the probability that non-infective material immunized by means of a slight amount of residual virus of extremely low infectivity.

It was found during the course of this work that the majority of the immune animals showed increased erythrocytic sedimentation rates at some time during the development of immunity. There seemed to be a definite relationship between immunity and changes in erythrocytic sedimentation rate.

This work indicates that definite immunity can be developed against the virus of poliomyelitis using virus rendered non-infective by formalin. However, in the concentration used, the formalin gave considerable skin irritation. Therefore, in the present work virus suspensions are being inactivated with lower concentrations of formalin.

MAURICE BRODIE

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COMPARING SOIL FUNGICIDES WITH SPECIAL REFERENCE TO PHYMATOTRICHUM ROOT ROT[1]

Phymatotrichum omnivorum (Shear) Duggar, the fungus that causes the highly destructive root-rot disease, attacks the roots of plants from a few inches to several feet deep in the ground. For this reason, none of the chemicals customarily used as soil fungicides have proved effective in eradicating this fungus even from small infested areas. Recent work has shown that a group of volatile chemicals,[2] relatively insoluble in water, have strongly fungicidal properties and appear of particular promise for use against this fungus and other soil organisms.

In preliminary evaluation of these and other possible fungicides, the direct toxic effect was tested as

[1] Published with the approval of the director as Contribution No. 286, Technical Series, of the Texas Agricultural Experiment Station.

[2] The writers are indebted to the Roessler and Hasslacher Company (now R. and H. Chemicals Department, E. I. du Pont de Nemours and Co., Inc.) for furnishing many of the chemicals tested.

follows: Small pieces of fresh sclerotial masses of *P. omnivorum* were placed on wads of moist absorbent cotton in culture tubes, the tubes placed inside 2-quart Mason jars, and materials to be tested placed also in the jars at 0.144, 0.72 and 2.88 gm per jar. The materials could act on the sclerotial masses only after diffusing through the air and through the cotton plugs of the tubes. After various periods of exposure the sclerotial masses were transferred aseptically to agar slants and growth observed. At the lowest concentration tested, pentachlorethane, tetrachlorethane, xylene and ammonia killed the fungus masses within 24 hours. Carbon disulfide and 14 other materials were less rapidly toxic; and naphthalene and alpha naphthol were not toxic within the limits of the test.

The ability of the materials to penetrate moist soil and then inhibit growth of the root-rot fungus was tested as follows: Mason jars were filled with moist Houston black clay soil, inoculum of the fungus placed against the glass at various depths in the soil, the materials to be tested placed on the surface, and the jar lids clamped tightly. The following materials, when added on the surface at rates of only 100 ppm of the air-dry soil weight, were able to penetrate to the bottom of the jars (135 mm with 1-quart jars) and there completely prevent growth from the fungus inoculum: pentachlorethane, tetrachlorethane, xylene, carbon disulfide, perchlorethylene, trichlorethylene, dichlorethylene, turpentine and paradichlorobenzene. Some of the materials were ineffective at the highest rates tested: New Improved Ceresan and the other organic-mercury compounds when added at 2,000 ppm; formaldehyde at 4,000 ppm; and ammonia even at 10,000 ppm.

Only pentachlorethane, tetrachlorethane and xylene were completely effective against the root-rot fungus, at the lowest concentration tested, by both methods.

A preliminary field test with tetrachlorethane was started late in the summer of 1933. Tetrachlorethane was applied around cotton plants in six comparable areas at the advancing edges of root-rot spots, 4 additional areas serving as checks. The material was poured into holes (4 per square foot) pierced with a crowbar to a depth of 6 inches. Rates of application were calculated on the soil-weight basis to supply, respectively, 500 or 1,000 ppm of tetrachlorethane to a depth of 4 feet. After 15, 21 and 32 days, trenches 2 feet deep were dug next to the plants, and the roots were separated from the remaining soil, cut into sections corresponding to various depths, placed in separate jars of moist soil, and kept under observation for at least a month.

Phymatotrichum strands grew profusely from the roots from all the check areas. From the 39 plants from the treated areas, on the contrary, there was no Phymatotrichum growth, except from the 12 to 16 inches deep portion of the tap-root of a plant located in exceptionally dense clay at the edge of an area treated at 500 ppm and dug after only 15 days. With this exception, the treatments were successful in killing the root-rot fungus on or within the affected cotton roots in the treated areas, to a depth of at least 2 feet.

Excavation of plants adjoining the treated plats showed that the fungicidal effectiveness of the treatment did not extend more than a few inches horizontally beyond the areas treated. There was no evident injury from the tetrachlorethane to either the treated or neighboring cotton plants.

Summary: Pentachlorethane, tetrachlorethane and xylene were most effective in laboratory tests of ability of volatile materials to kill the root-rot fungus *Phymatotrichum omnivorum,* and to penetrate moist soil and inhibit growth of the fungus. In a preliminary field test, tetrachlorethane placed in the soil at a depth of only 6 inches killed the fungus on cotton roots to depths of at least 2 feet. These highly toxic, soil-penetrating fungicides appear promising for further trial against Phymatotrichum root rot, and are suggested for trial also against other injurious organisms found in the soil.

WALTER N. EZEKIEL
J. J. TAUBENHAUS

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS PRESENTED AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

By WATSON DAVIS, *director, Science Service*

A DEVICE that automatically takes the talk, including advertising, out of radio programs has been devcloped by Professor Gleason W. Kenrick, of Tufts College, Massachusetts, who demonstrated this radio talk eliminator. Seemingly endowed with intelligence and discrimination, this robot radio censor looks like a supplementary radio set that is hooked up with a conventional radio broadcast receiver. Actually, the talk eliminator works automatically and utilizes a combination of electrical devices which result in the impartial suppression of all talk and announcements, along with advertising "plugging," that some radio listeners find objectionable. The radio talk eliminator hook-up is such that whenever there is a quarter of a second silence in the program, the radio set is silent for ten seconds. When a speaker stops for breath, his momentary silence, detected by the talk eliminator, in turn silences the radio to his message for ten seconds. The detecting "brain" in the talk eliminator is a detector amplifier similar to the automatic volume control devices now commercially incorporated in radio sets. Whenever the current in the "brain" tube drops to zero for the predetermined fraction of a second, a selective relay comes into action that silences the radio for a predetermined length of time. Professor Kenrick has found that setting the talk-hating robot for ten seconds of silence is an effective antidote for most radio chatter. A very fast talker, like Floyd Gibbons, can beat the eliminator which can not silence him until he stops for breath. Music, which is usually continuous, passes inspection by the censor robot except in the rare instances when there are dramatic pauses as there often are in symphonic compositions. Radio broadcasting stations will be able to counteract the use of the talk eliminator, if many listeners equip their sets with them, by supplying a musical background to all announcements and advertising speeches. But if the talk eliminator is thus thwarted, Professor Kenrick promises to improve it by adding some sound filters which will have the ability to differentiate between musical sounds and the sound of the human voice.

THE idea that fever speeds up our time, recognized popularly in the phrase "feverish activity," has been proved sound by Professor Hudson Hoagland, physiologist of Clark University, Worcester, Massachusetts, who presented evidence of a chemical time clock. He found that patients with a fever, or well persons heated up internally with high frequency electricity, think times passes faster than it really does. Delving into laws of chemistry, Professor Hoagland discovered that the speed of counting seconds appears to obey the well-known relation described by Arrhenius between chemical reaction and temperature. In addition to this evidence that the body and the brain obey chemical laws, he also found evidence for a definite irreversible chemical reaction within human beings that serves as a sort of master clock for our judgment of short intervals of time.

THE longer you listen, the keener your hearing becomes, provided the noise is not too loud, Dr. E. M. Josephson, of New York, told the scientists in putting forth a new hearing theory, in which it is assumed that the mechanical energy of the sound is converted by the cochlea into electrical energy which affects the auditory nerve. Normal ears do not become fatigued, and fatigue is the earliest sigh of progressive deafness, Dr. Josephson contended.

PHYSICIANS in private practise should not fear competition from organized medical work in preventive and routine care of working classes, as Henry H. Denison, the manufacturer, by analogy, with business experience predicted that organized medical service is not likely to exceed more than fifteen per cent. of the whole field of medical practise. Mr. Denison described expanded medical service as a vast useful field that will take care of any technological unemployment that might result from more efficient organized medical services.

FISHES thrive best in water that is not too clean, Professor W. C. Allee, of the University of Chicago, told the scientists. They like to swim in water that has been inhabited for some time by their own kind.

"A ROSE by any other name would smell 6523." This revised version of a famous saying occurred to many scientists at the meeting when they viewed a flavor and odor chart devised and exhibited by Ernest C. Cricker and Lloyd F. Henderson, associated with Arthur D. Little, the Cambridge, Massachusetts, industrial chemist; for 6523 is the odor formula for the rose. Other smells can be given numerical labels of this sort and these can be used to designate them just as numbers are convenient in tagging convicts and motor cars. Each digit expresses one of four components in odor sensations, which in order of writing are fragrant, acid, burnt and caprylic. The numbers indicate intensity on a scale of eight. The meaning of caprylic may be understood if it is known that the word is derived from "goat." Mothballs, or naphthalene, in this code rate 4564, while the familiar gas of rotten eggs, hydrogen sulfide, is 5346. The sweetest smell reduced to this odor code so far is that of vanillin, 6021, and that may explain why so many of us like vanilla flavoring. A rather terrible smell, strangely used as a basis for some of the most expensive perfumes, is skunk-like civet, 5777. But the scale failed when the chemists attempted to express a still more disagreeable smell, that of butyl mercaptan. The odor scale is finding practical use in the perfume and essential oil industry.

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OTHER scientists reported: There was probably only one race of human beings in that portion of pre-history known as the upper old stone age, not three as usually believed, according to Professor Gerhardt von Bonin, of the Field Museum, Chicago. Phonograph records are being used to record dialects, linguistic usage and folk tales of New England, according to Professor Miles L. Hanley, of Harvard. Oleic acid on surfaces will cause water vapor to condense in drops and hasten this process fundamental to steam power product, it was demonstrated in an exhibit by T. B. Drew and W. M. Nagle, of Massachusetts Institute of Technology.

A NEW idea of how the human body fights its defensive battles against disease invasions was presented by Professor Reuben L. Kahn, of the University of Michigan, who reported evidence that skin, muscles and other fixed tissues, and not the blood, are the "shock troops" in our continual struggle to keep healthy. Usual medical thought considers the protective forces against germ invasion centered largely in the blood and other body fluids in which are found phagocytes, or bacteria-eating cells. Skin and muscle are usually considered hypersensitive to the same germ that, because of protective immunization, is subdued by the blood. Experimenting with rabbits treated with much the same sort of serum that is so successfully protecting thousands of children against diphtheria, Professor Kahn finds that skin and muscle as well as blood receive immunity when the living body is given protective treatment. In fact the skin, probably because it has been the armor of the body throughout the ages against attack by germs and other harmful agents, is ten times as effective as muscle, brain or blood in combining with and subduing the invading material. Immunity is an ability to detect and then anchor, or combine with, an invading substance; and the great service rendered by a tissue is this combining with the dangerous substance in order that it may not spread throughout the body with disastrous results. Professor Kahn explained that in a germ disease this combining capacity of the tissue may determine whether the trouble is localized or whether the organisms run riot throughout the body. Sometimes the ability to protect is not evident from the blood, yet the skin is on its protective job. This is the case sometimes in Malta fever and in boils caused by staphylococci. The inflammation of infection, as in a boil, is really something to warrant rejoicing because it means that the invading organisms are being destroyed and eliminated. Further studies by Professor Kahn promise to explain some puzzles about infection and give information that physicians may be able to use in the actual treatment of disease.

SIGNIFICANT differences between the germs that cause tuberculosis in humans and those responsible for the disease in other animals have been discovered, and a corps of research workers are hard at work upon the difficult task of attempting to translate these research findings into methods of preventions and cure of tuberculosis that doctors can use, according to Dr. William Charles White, chairman of the National Tuberculosis Association's Committee on Research. The human tubercle bacillus has within itself one substance, a fatty acid, that occurs in none of the other tubercle germs, Dr. R. J. Anderson, of Yale, has discovered. The chemical substance is able to produce the tubercle growths characteristic of the disease without the presence of the bacilli themselves. So far, Dr. Anderson's studies have been confined to only one strain of the kind of bacilli occurring in human beings, but the research is being rushed to include all the human strains. Another promising lead to the possible conquest of the white plague is the fact that the germs that cause the disease have much greater difficulty getting along without oxygen than the germ strains that are relatively harmless. Again this peculiarity has not been practically applied. Preparations are being made to study the life, loves and experiences of a single individual tubercle bacillus, Dr. White explained. Heretofore only large colonies or "herds" of the germs have been observed because of the difficulty of singling out individuals. It is hoped that helpful details of germ life will be found in this way, just as observations of individual men, women and other animals reveal facts that are not discovered by watching crowds.

PHYSICISTS must continue their search for a clean-cut case of the conversion of radiant energy into matter, Dr. Carl D. Anderson, of the California Institute of Technology, declared in describing his discovery and investigations of the positron, the positive running-mate of the familiar electron or unit of electricity. When lead, or aluminum, or other material is bombarded naturally or artificially with cosmic rays or powerful gamma rays, positrons and electrons are often seen to emerge. The theory of Dr. P. A. M. Dirac, British physicist, is that these, which are like visible light, only shorter, are actually transmuted into these particles of matter under the influence of coming close to the kernels of atoms. But Dr. Anderson, from his experiments in Dr. R. A. Millikan's Pasadena laboratory, concludes that what happens is that the rays merely knock out electrons and positrons already existing in the atomic kernels.

DETECTION of murder by poison will be made more sure by a new and accurate method of analyzing human blood to detect and estimate extremely small quantities of alkaloid drugs such as cocain, strychnine and morphine. The new technique, devised by Dr. Burnham S. Walker and Elizabeth W. Walker, of Evans Memorial and Boston University School of Medicine, will detect six parts of drugs in one hundred thousand parts of blood. It will also be used in gaging the proper dose of these powerful drugs in legitimate medicine.

INDUSTRIAL laboratories are now contributing almost as much to the fundamental progress of science as universities and other wholly academic institutions, Dr. Paul D. Foote, Pittsburgh industrial physicist, said. In the last eight years, for instance, fifty million dollars has been spent by petroleum companies in improving the technique of applied geophysics useful in locating oil underground.

COAL is king, and this source of power and new chemical products is more firmly seated on its throne than ever before, according to Professor George B. Roorbach, of the Harvard School of Business Administration. New synthetic chemical products depend largely upon coal, including synthetic nitrogen, synthetic phosphoric acid, acetic acid and the vast army of dyes, drugs, perfumes, photographic materials, synthetic resins and tanning materials. Regions of the earth that have abundant, readily available coal supplies are in an even more preferred position for industrial dominance than heretofore.

GREAT winds blow in the atmospheres of the distant stars compared with which the hurricanes of the earth's atmosphere are mere zephyrs. Dr. Otto Struve and Dr. C. T. Elvey, of Yerkes Observatory of the University of Chicago, announced that while the outer gaseous atmospheres which surround the luminous lower strata of the stars have heretofore been assumed to be relatively quiescent, they have discovered in the rainbow spectra of stars evidence that powerful turbulent currents exist in the atmospheres of many stars. Spectroscopic phenomena that have puzzled astronomers for years are now explained, and Drs. Struve and Elvey even measure the most frequent wind velocity of individual stars. The faint star known as 17 Leporis has an atmospheric velocity of about forty miles per second. In Epsilon Aurigae it is twelve miles per second and in the first magnitude bright star Alpha Persei it is about four miles per second. In the sun, which is a star, there is practically zero wind velocity, however. The winds in the stars may be likened to the winds on earth although the densities of stellar atmospheres are much lower than the density of earthly air.

ASTRONOMY seems to be on the verge of being able to "see" the invisible star light, both longer and shorter in wave-length than visible light from the stars, that can not now be satisfactorily studied by conventional telescopes and mirrors, Dr. Paul W. Merrill, of the Carnegie Institution's Mount Wilson Observatory, told the astronomers. Photoelectric cells, new photographic emulsions and thermocouples, bolometers and radiometers, devices for measuring feeble temperature differences, are being improved to such an extent that astronomers should in the near future be able to extend their present fragmentary knowledge of the distribution of energy in the stellar spectra.

TWO familiar green aniline dyes, made from coal tar, are effective in combating and subduing some of the common skin infections that are due to fungi, Dr. A. McCrea, of Parke, Davis and Company, Detroit, reported. These dyes, known as malachite green and brilliant green, were found to be outstanding in killing action, far surpassing all others tested, including aniline violet, fuchsin basic and gentian violet.

X-RAYS of the bones in children's wrists give a good index of the rate at which they are growing, and how near they are to maturity, Dr. Psyche Cattell, of Harvard University, reported. The shadow pictures showed a correlation between the solidifying of the bones and the physiological age of the children. Among other things, Dr. Cattell discovered that girls who are "big for their age" slow up in their rate of growth from one to two years earlier than do girls who are smaller.

A MEANS of quickly reversing the deep unconsciousness caused by ether and other anesthetics and, in some cases, of bringing back from the brink of death overanesthetized patients, was announced by Dr. Walter V. MacGilvra, a dental surgeon of the Harvard dental school, after experiments in which the Harvard medical and dental faculties have cooperated. A shot of weak hydrochloric acid injected directly into the blood is the agent that has been found effective in recalling and restoring to sensibility patients who would otherwise sleep for hours, and in some cases would never awake. While Harvard scientists have demonstrated the effectiveness of this new medical method, it was a young woman technician in a medical laboratory in Joplin, Missouri, who, by following what is now believed to be a wrong theory, actually discovered the method. Miss Pearl L. Moorman, in an effort to save an animal with which she was working, introduced a minute dose of acid into its blood and found that it awoke from anesthesia. She wrote Dr. MacGilvra an account of her discovery, and both he and a Kansas City medical laboratory verified her results, although her theory that anesthesia makes the blood more alkaline and that therefore acid would reverse the process has not been substantiated. This acid method of terminating anesthesia has been christened "Palinaesthesia," the name having been selected with the blessings of the Eliot professor of Greek at Harvard, Professor Charles B. Gulick. Because extreme alcoholic intoxication, asphyxiation, near drowning, severe electric and other shocks are very similar to the purposely induced anesthetic states caused by ether and other drugs, Dr. MacGilvra believes that injections of weak hydrochloric acid will prove effective in rescuing and bringing back to full use of the faculties, those who suffer from such difficulties. Palinaesthesia has not yet been tried on an extremely intoxicated person simply because Dr. MacGilvra has not yet had such a case made available to him. The first use of palinaesthesia on a human being was made by Dr. MacGilvra and Dr. Alfred Ellison, then resident surgeon at the Worcester Memorial Hospital, last July. It was a real emergency. A patient had had an unusual reaction to avertin and following an operation he was plainly in a dying condition. As a heroic measure, Dr. MacGilvra, using the experience of successful experiments on rabbits, injected a weak solution of hydrochloric acid in the patient's veins. There was an immediate improvement with the first few drops that entered the blood, and 40 minutes after the first injection, the patient, who had been so near death, was actually awake and answering questions. That night the patient complained of annoying wakefulness. Seven more times palinaesthesia has been used on human patients, each time with striking results. Now the doctors are ready to suggest its use not only in emergencies to save life that might be taken by unusual effects of anesthetics, but as a routine method of awakening patients early after operations.

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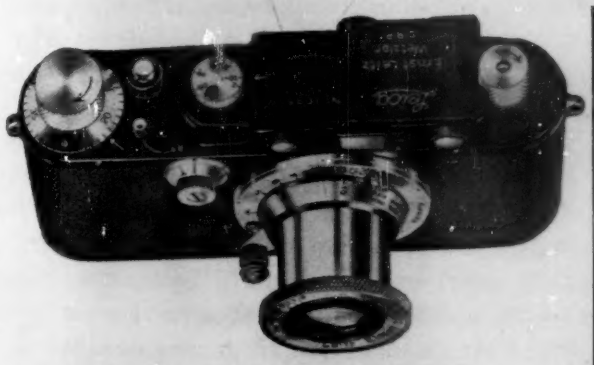

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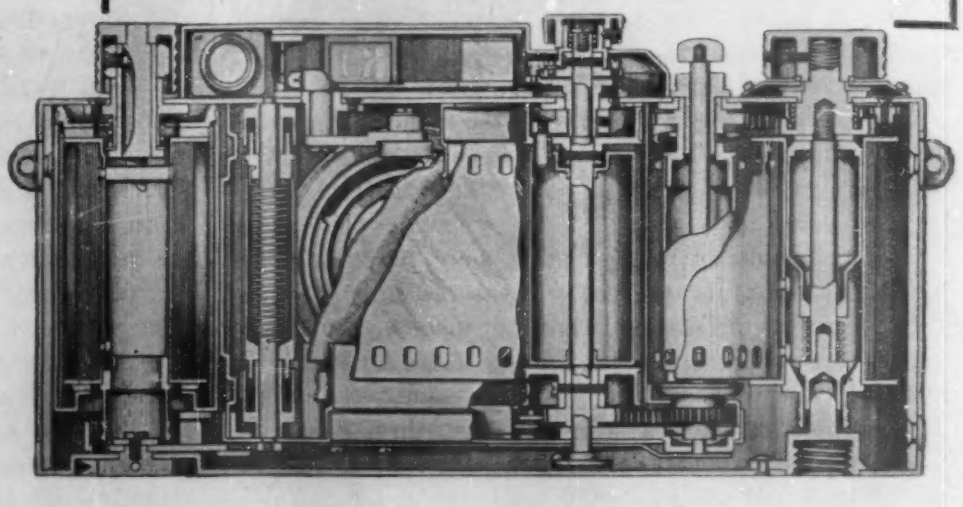

SCIENCE NEWS

Science Service, Washington, D. C.

THE DEATH-RATE IN THE UNITED STATES

THE death-rate for this country for the calendar year 1932 was the lowest ever recorded. This statement was contained in the annual report to Congress of Surgeon-General Hugh S. Cumming. U. S. Public Health Service, which covers the activities of the service for the fiscal year ending July, 1933.

Unusually favorable health conditions prevailed during the first half of 1933 and the indications are that the year just ended will also prove to have been an unusually healthy one. Preliminary reports from large cities of the country for 1933 indicate a still lower death-rate than before recorded, being less than 12 per 100,000 population.

Although the death-rates have remained low, the surgeon-general is conducting special surveys to determine what effect the depression may be having on sickness and mortality in persons formerly in moderate or comfortable financial circumstances but recently much reduced in income.

He reported that preliminary analysis of a study of about 1,000 families in eight large cities indicates higher sickness rates among those of reduced income, especially among those in better circumstances in 1929, but now without employment and on low income, supplemented in some instances by welfare organizations.

Comparing the great reduction in the communicable diseases in the United States since the beginning of the present century, Dr. Cumming pointed out that in 1900 the tuberculosis death-rate in this country was 201.9 per 100,000 population, while in 1932 it was only 61.3; the diphtheria death-rate dropped from 43.3 per 100,000 to 4.8, and typhoid fever from 35.9 to 4.60. The total saving of lives from these three diseases alone, as compared with 1900, was 263,000; while if the 1900 total death-rate in the United States had obtained in 1932 there would have been 800,000 more deaths than actually occurred.

There were only 10,887 cases of smallpox reported in 1932, as compared with 28,755 in 1931 and 46,560 in 1930—a 77 per cent. decrease in 1932 as compared with 1930, and the death-rate for this disease was the lowest ever recorded by the Public Health Service—only 4 per 10,000,000 population. And yet the suffering and death caused by these cases could have been prevented if the means readily available had been applied.

There was actually a decrease in the number of deaths from pellagra in 1932 as compared with the two preceding years, although an increase might have ordinarily been expected as a result of the economic depression. This usual tendency was probably more than offset by health education and preventive measures.

No cases of the dread diseases of plague, cholera or yellow fever occurred in the United States during 1932, although all were present in other countries. About 75,000 cases of cholera were reported throughout the world, plague was wide-spread and yellow fever was reported in Brazil and in several countries in Africa.

An important part of the work of the Public Health Service is the prevention of the introduction of diseases from abroad, in which during the past year, the one hundred and thirty-fifth of its existence, the service was highly successful. Commercial intercourse has long been recognized as an important means of the spread of epidemic diseases, and the increasing use of aerial transportation has added to the danger.

How the service protects the health of travelers in this country may be seen from the fact that 95 per cent. of the sources of drinking water used by railroads and bus lines, 97 per cent. of the sources used by vessels and 97 per cent. of those used by passenger airplanes were inspected and controlled by the U. S. Public Health Service. Formerly these supplies were the cause of many cases of typhoid fever.

SAND DEPOSITS

SANDSTONES were once loose sand, and the fossils that are embedded in them were parts of living animals or plants for which the sand was an environment. For this reason a study of present sand deposits can yield information of value in understanding the processes that went on when sandstones of different types were in the making. At the recent meeting of the Paleontological Society in Chicago, Professor W. H. Twenhofel, of the University of Wisconsin, reviewed the principal types of sand deposits, and their relations to the creatures that live on or in them.

Sand deposits can be grouped under five heads, according to Professor Twenhofel: Wind-blown sand, sandy parts of alluvial fans, river sand, shore sand of lake or sea and lake or sea-bottom sand. Each type of sandy environment offers harborage to a different class of living community, each presents different problems for its inhabitants to solve, and each has a different complex of factors that make either for their preservation as fossils or for their destruction before they can become fossilized.

Thus, wind-blown sand is essentially a desert habitat, even when it occurs in the midst of a relatively humid land. The plants that grow on it are succulents, like the cactus, or leathery-leaved shrubs, like the beach plum. The animal population will be predominantly small in size, with low water requirement: insects, lizards, mice and other small rodents, and the tougher kinds of snails.

Chances of permanent burial resulting finally in fossilization are relatively poor in wind-blown sand. Burial occurs, but it may not last: later winds, or the waters of a cloudburst, may rake the sand away again. Besides, the penetration of air into the sand encourages fairly complete decay. For this reason, sandstone resulting from wind deposits are usually poor in fossils.

Bottom sands of ocean and lake are at the other extreme. The animal and plant life forms found in and on them are naturally largely aquatic or at least amphibian; though strictly terrestrial forms may occasionally drift down, drowned, from shore sources. Move-

ment is much less than in other types of sand deposit, and hence chances of permanent burial and fossilization are much better.

THE PHOTOELECTRIC CELL IN THE TEXTILE INDUSTRY

ADAPTATION of photocells to the textile industry in the cutting of cloth labels at a plant in Grand Rapids, Michigan, is seen by engineers as a step toward continuous production of felts, upholsteries, toweling, blankets and other loom-width materials. Racking of textiles before cutting is eliminated by the process.

Printed cloth labels are fed from a roll to a caesium photocell, with a heavy cross strip of ink as a register mark. The labels are printed by a machine which makes 70 impressions at one stroke. The printed register mark, when it passes in front of the phototube, sets up an electrical disturbance, which is amplified to operate a thyratron tube (grid controlled rectifier). The latter tube affects operation of an electro-magnet solenoid which is on a rocker attachment. This solenoid clamps momentarily on the label tape and draws it backward. Thus, correction of register is on a backward instead of the forward movement of the label tape.

The photocells are affected by penetration of light rays through the cloth, one of the first instances where the "electric eye" has been applied to substances other than transparencies without resorting to picking up light variations by reflections. The light shines through the cloth label, which passes directly over it, cleaning the top of the bulb so that dust or lint does not blur the light intensity. While the label tape is being drawn forward by a peculiar type of steel "finger" grips, the light which affects the photocell is turned off. Thus, no shutters on the photocell aperture were necessary and at the same time no electrical disturbance is set up by the printed matter on the label proper. The light only goes on at the end of the feeder stroke, or approximately the time when the register mark is under the photocell aperture. The solenoid then pulls the label tape backward so that register is perfect. A knife comes down, cutting the labels apart, and another attachment folds the ends over and irons them before packing the labels 500 in a box. The entire process is automatic.

Should register not be perfect, due to a misprint on the label, or if the phototube fails to respond to changes in light intensity, a system of electrical relays throws a clutch and stops operation of the machine until an operator can readjust it. The machine completes 43 labels a minute. Although now only adapted to ribbon widths, it is said the phototube principle can be applied to cutting loom-width textiles also, just as packaging machinery using photocells cuts paper rolls several yards wide. Continuous production would then be assured.

NEGRO–INDIAN MIXTURES IN MEXICO

ZAMBOES, Negro-Indian mixtures on the Black Coast of Guerrero, southern Mexico, have been visited by the joint Mexican-Italian expedition which is making anthropological and sociological studies of peoples in Mexico.

African blood, which dates from Spanish slavery times, tints the whole Guerrero coast a darker shade. After several centuries many villages of comparatively pure Negroes still exist, often side by side with groups of approximately pure Indians.

In an unmixed state the Negroes look down on Indians, calling themselves "people of reason." The Indians, for their part, if asked whether Negro mixtures exist in their villages, answer proudly, "we are Indians." Yet the two have mixed, chiefly through the medium of Spanish blood. Negro blood is at once noticed. Coast people of darker-than-Indian coloring are taller, handsomer, more violent, more spontaneous and less moral.

Indian blood is a remarkable hair straightener. Five degrees of hair are commonly recognized on the Black Coast. There is cuculuxtle—an Aztec Indian word—which refers to tight-kinked African hair. Chino is hair tightly curled in ringlets, resulting from a small dilution of the Indian and his uncurlable hair, with the Negro. More Indian blood produces crespos, or looser waves. Then there is pelo quebrado, "broken hair," which is Indian hair only slightly softened from straightness.

Almost at a glance differences between the races are apparent. The Indian of the interior is almost frozen into a conventionalized pattern. The Indian walks as if he were part of a painted frieze, and his face is not the window of his soul. The Negro is fresh, and stalks with a jazzy air. The Indian loves trees, and lets them grow around his hut to shield him. The Negro cuts down every living thing of green, living boldly in the glaring sun.

In the Indian régime, the man is lord of his woman. Monogamy is the rule, and if any one varies from the path it is the man. Among the Negroes, the woman is the stable pillar of the not very stable family, and the two sexes are almost equal. About her the children bred by different fathers collect. Negro women are fishers, butchers or dressmakers, housework being incidental. Indian women are rarely thus professional.

Although the Negro has not been changed emotionally by living side by side with the Indian, he has nevertheless become quite "Indian" in material culture. Little difference is noted between Negro and Indian huts. Both races sleep on Indian straw mats, eat Indian corn, chile and calabashes, grind grain on Indian stone metates, use Indian style pottery and hollow gourds. Some persons consider the circular hut, typical of the tropical Black Coast, as African in origin, but the question is not settled.

BUFFALO AND THE GLACIER NATIONAL PARK

"A VENTURE in landscape zoology," is the way that George M. Wright, chief of the division of wild life studies of the U. S. Office of National Parks, Buildings and Reservations, describes the project to reintroduce buffalo to the eastern portion of Glacier National Park, Montana, and the adjoining Blackfeet Indian Reservation.

Both park officials and those of the Office of Indian Affairs are greatly interested in the project, and it is hoped that a nucleus herd may be introduced into the Glacier area next spring.

Buffalo once were native to the east side of Glacier Park and to the Blackfeet Reservation, but this area, like all buffalo ranges, became depleted when the great plains animal all but succumbed to extinction following the uncurbed buffalo hunting of frontier days.

It now is planned to introduce a nucleus for a buffalo herd into Glacier Park and the Blackfeet Reservation from the Yellowstone surplus.

Glacier Park still has its wilderness character—its mountains, glaciers and waterfalls, and much of its native wild animals—and the Indians of the adjoining Blackfeet Reservation add color to the scene. But the picture is not complete without the buffalo, which in the past meant so much in the economic life of the Blackfeet.

The plan now under consideration calls for the transfer of a nucleus herd of about fifty buffalo, of varying ages and fairly representative of the normal Yellowstone herd. These animals would be transported by truck to a fenced inclosure of approximately one township in area on the west side of the Blackfeet Reservation where they would be held for possibly a year. After that time they would be turned out of the paddock in summer to range within Glacier National Park, and in winter would range on the Blackfeet Indian Reservation.

Under this scheme responsibility for the management of the herd would rest with the Blackfeet, and as a surplus developed the excess animals would be available for use by the Indians.

DAMAGE FROM EARTHQUAKES

EARTHQUAKES again slew their thousands in the year just past, although at that it was not an extraordinary earthquake year. A strong, destructive shock took about 120 lives and wrecked $41,000,000 worth of property in the Los Angeles-Long Beach region on March 10. That was the only "killer" quake in the United States during the year; but there were others even more destructive in other parts of the world.

The worst, probably, was the one that wreaked terrible damage along the east coast of Japan on March 2. This was apparently a submarine earthquake, centering in the Japan Deep. The official report of the Japanese Government listed 1,560 persons killed, 956 missing, 354 injured, 2,878 houses washed away by the tidal wave that the quake caused, 1,458 houses thrown down and 211 houses burned. The sea wave was recorded as far away as Honolulu and San Francisco.

Three other "killer" quakes were recorded during the year. On April 23 a severe earth shock wracked the Greek island of Kos and the shores of Asia Minor, killing about 100, injuring 500 and rendering 5,000 persons homeless. The west coast of Sumatra was shaken on June 24, with 70 natives reported killed near Benkoelen. The interior of China, near the Tibetan border suffered a strong shock on August 25; a hundred deaths were reported in Szechwan province.

One of the most violent earthquakes of the year occurred in Baffin Bay on November 20. Its tremors, traveling for thousands of miles through the rocks at the surface and deep within the earth, reported its occurrence through hundreds of seismograph instruments all over the earth. This was the only source of news about the Baffin Bay earthquake, for the region is uninhabited, so that there could be no cabled or radioed reports of people killed and the works of their hands laid in ruins. This quake was extraordinary not only for its violence but for its location: no major earthquake had ever before been recorded in the Baffin Bay region.

All these and many other earthquakes were traced to their points of occurrence, or epicenters, by means of a cooperative reporting enterprise participated in by the U. S. Coast and Geodetic Survey, other governmental agencies in foreign countries, the Jesuit Seismological Association and numerous university observatories, with Science Service acting in a liaison capacity. The instruments at a single observatory can tell when and how far away a quake occurred, but can not locate the exact spot. But when their data are wired or cabled to Science Service and compared by the Coast and Geodetic Survey seismologists, arcs from two or more stations can be struck on a map, and their intersections give the location of the epicenter.

ITEMS

AN international institute for psychical research that will investigate claims of spirit phenomena using strictly scientific procedures and the recognized tests of physics and physiology has been organized in London. Foreign as well as British scientists are being invited to participate. Professor G. Elliot Smith, University of London, is president of the new institute and associated with him are: Sir Charles Sherrington, Oxford University; Professor E. D. Adrian, Cambridge; Professor E. W. MacBride, Imperial College of Science; Dr. David F. Fraser-Harris, author of physiological works, and Professor Julian Huxley, King's College. None of these, although recognized in the fields of scientific research, claims any special knowledge of psychical phenomena.

SOUNDS well within the audible range, if they are intense enough, will produce a chemical change in various substances, it has been found by Drs. Earl W. Flosdorf and Leslie A. Chambers, of the University of Pennsylvania School of Medicine. An egg was coagulated as though soft boiled by these audible sounds. Ethyl acetate was broken down to produce acetic acid, vegetable oils were "cracked" with the generation of acetylene gas, and starch was to a slight extent decomposed to produce glucose. The sound vibrations used ranged in frequency from 1,000, about two octaves above the middle C on the piano, to 15,000, which is a very shrill squeak.

KANSAS once had crocodiles. Solid evidence to this effect has been found by Dr. M. G. Mehl, of the University of Missouri, who described his discovery before the Chicago meeting of the Paleontological Society. Dr. Mehl's discovery consists of a fossilized crocodilian skeleton, its skull and some other parts missing. From the parts that remain, the original length is estimated at about twelve feet. The skeleton was uncovered near Salina, Kansas.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE MEASUREMENT OF THE SPECIFIC CHARGE OF AN ELECTRON

THE most highly developed parts of that highly developed field of the new physics, quantum mechanics, are not good enough to predict the results of clever experimenters. The Zeeman effect, which describes the behavior of an atom in a magnetic field, and the light given out by the hydrogen atom are the subjects under fire.

So complacent is the physicist about these matters that the discrepancies would not be believed were they not put forward by the highest authority in the field. Professor V. W. Houston, who has announced these results obtained at the California Institute of Technology with the collaboration of Professor Y. M. Hsieh, of Yenching University in China, and L. E. Kinsler, a graduate student, is known to have done the best experimental work in both these fields. He is at the same time one of the country's foremost theoretical physicists so that his interpretations must be considered as quite reliable.

Professor Houston had worked up a method based on the supposedly sound theory of the Zeeman effect for measuring the specific charge of an electron. His results were accepted and revised all previous work. Now with Mr. Kinsler he has found that in the simplest and apparently surest case, namely that of helium, the specific charge seems to come out wrong. Any physicist would have bet a hundred to one against this result.

In the other experiments with Professor Hsieh on the fine structure of the hydrogen spectrum the results are startlingly different from the predictions of the equation of Professor P. A. M. Dirac, the British physicist. This equation represents the pinnacle of achievement in theoretical physics and was the main contribution of Professor Dirac who recently was awarded the Nobel Prize. But Professors Houston and Hsieh show that even this equation is not good enough for exact work.

The difficulty with the theory seems to be that it treats the atom as if it were alone in space. Actually it is connected with its surroundings through electromagnetic fields. In other words it is part of the whole universe. How to take this interaction into account is likely to prove an extremely difficult problem.

ORIGIN OF THE POSITRON

THE idea that a bundle of radiation, such as a cosmic or gamma ray quantum, collides with an atomic kernel or nucleus, and gives birth to a positive electron or positron, receives support from calculations made by Drs. W. Heitler and F. Sauter, working at the University of Bristol and the Technische Hochscule at Berlin-Charlottenburg.

There has been considerable discussion as to just what happens when powerful radiation smashes into matter and particles fly out. Some physicists have interpreted these experiments as the conversion of energy into matter, while others suggest a blasting of the atom's center, releasing particles already there.

The widely acclaimed electron theory of Professor P. A. M. Dirac, the British physicist and Nobel laureate, and his formulation of the wave equation so as to explain experimental findings about the hydrogen atom, can be used to explain what happens if a fast electron, passing through matter, emits a quantum of radiation with energy comparable to its own, and the reverse happening, if a quantum of radiation colliding with an atomic nucleus gives birth to a positive electron.

The production of a pair of electrons by cosmic radiation in the presence of an atomic nucleus has been reported as the result of experiments at Cavendish Laboratory, Cambridge, England, by Professor P. M. S. Blackett and G. Occhialini, although Dr. Carl D. Anderson, of California Institute of Technology, Pasadena, California, discoverer of the positive electron takes the view that the electrons produced by cosmic rays smashing into matter are probably not created out of radiation, but are merely fragments of the atom's heart that has been disrupted.

Drs. Heitler and Sauter have calculated from the Dirac equation what is to be expected when radiation turns into electrons and the result agrees well with the experimental results. For the opposite process, similar calculations show that the theory seems to disagree with experiment. But the physicists explain that the Dirac wave equation may not apply to the very small radius of the electron and when the radiation has a wave-length that is smaller than this radius.

THE 200-INCH MIRROR OF THE MT. WILSON OBSERVATORY TELESCOPE

THE disc of the great 200-inch mirror of the new Mount Wilson Observatory telescope now being built will be made of a superior sort of pyrex glass and it will be poured at Corning, New York, in about a month.

Early plans called for a mirror of fused quartz, but now a superior pyrex glass, which has a small volume change with temperature, has been developed for the special purpose of the 200-inch mirror. When a few years hence the new giant telescope is placed in operation on a southern California mountain peak, it will be the world's largest, doubling in one gigantic step the diameter of the world's largest, the 100-inch on Mount Wilson, California.

At the Corning Glass Works, when the step takes place, the glass will be taken from the furnace at 1,500 degrees Centigrade, trucked to the mold and poured at about a thousand degrees. It will be allowed to cool to below 500 degrees and kept until the temperature is uniform throughout. For an ordinary disc 30 inches thick, 24 days would be enough to equalize temperature, but the thick mold which will hold the glass will require a longer time, probably over four months, before the cooling process can begin. This subsequent stage will take about the same length of time.

Dr. J. A. Anderson, of the Mount Wilson Observatory, discussed the annealing of glass before the Astronomy and Physics Club at Pasadena, California, and told how the problems involved were solved by American scien-

tists when our European sources of optical glass were shut off during the World War. The staff at the Geophysical Laboratory of the Carnegie Institution of Washington was especially effective. Their work has made the production of the enormous disc feasible.

The oven for the large reflector has already been used to make the 120-inch test plane required for the large concave mirror. Dr. F. Pease, who watched the pouring, said the result was most successful. Preliminary tests for strain showed it to be superior to the excellent 60-inch mirror now used on Mount Wilson. It was perfectly clear and almost free of bubbles.

The test plane will have the same type of construction as the big mirror. A hexagonal system of ribs will give rigidity without bulk. Nineteen points of support will be provided in these ribs. The supporting levers will be attached in ball bearings so that frictional and elastic distortions will be minimized. The holders will work in any position so that the mirrors can hang upside down if necessary.

THE TREATMENT OF DISEASE BY SHORT RADIO WAVES

A NEW device for treating disease by very short radio waves is being shown at the Physical Society's exhibition in London. Lung abscesses, empyema, carbuncles and infectious arthritis are among the diseases that have yielded to attack by this weapon of modern physics. The device was developed in Germany.

The wave-lengths used vary from four to fifteen meters. They are the type now being investigated by Marconi, and used experimentally by amateurs. The new device, an ultra short wave oscillator, is used to treat various diseases by changing the wave-length. A given wave-length seems to affect living matter, like bacteria or "germs," to a varying extent depending on the composition of the living matter. For example, Dr. Erwin Schliephake, of Giessen, Germany, found that with the new apparatus he could kill one common type of micro-organism, the staphylococci, in the body, but the rate of speed at which the organisms were killed depended on the length of radio wave used.

Cases of actinomycosis, or lumpy jaw, could be cured by waves four meters long, Dr. Liebesny found, but were unaffected by waves fifteen meters long. Nasal empyema was healed by treatment with waves of four to six meters.

The new device is not diathermic, since plates of glass insulate it from the body. It is possible to raise the temperature of the whole body more than seven degrees Fahrenheit in from forty to ninety minutes by means of the oscillator, but local heating depends on the degree of ionization of the cells.

The effect of the short waves seems to be to weaken the invading bacteria, to cause a migration of the white blood cells to the site of invasion, and to increase the destruction of the micro-organisms by the scavenger cells of the body.

AMOEBIC DISEASE IN A GROUP OF COLLEGE STUDENTS

MINUTE animal parasites, some of them the kind of amoeba that caused the dysentery which was reported as epidemic and took death toll in Chicago this summer, are more wide-spread in the general population than has been suspected, Drs. D. H. Wenrich, R. M. Stabler and J. H. Arnett, of the University of Pennsylvania, conclude as the result of a survey of 700 freshmen entering college in 1931 and 1932.

A single examination made for each person showed that about one in twenty harbors the parasite, *Endamoeba histolytica*, which causes the amoebic disease and belongs to the group of microscopic animals known as the protozoa. But five or six examinations may be required to determine the actual percentage, so that probably about ten per cent. of those examined harbor these parasites. Most of those with the parasites are not ill, but are carriers who, through carelessness, may infect others in their community. This is especially true if they are food-handlers.

Surveys made recently in Tennessee show that in the rural populations of that state probably one in five persons harbor the disease-producing amoeba. Closer to the tropics the incidence of the parasite tends to be larger.

One third of the college freshmen tested once by Drs. Wenrich, Stabler and Arnett were found to harbor one or more of seven kinds of protozoan parasites, including the dysentery-producing amoeba. Four other kinds of amoeba are likely to be confused with the disease-producer and expert knowledge is needed to make the diagnoses. Two other parasites belonging to the flagellate protozoa were found and these are thought by some to produce a mild illness in susceptible persons.

MEASURING THE INSIDE OF THE SKULL

THE first instrument enabling science to measure accurately the interior of the human skull has been invented, scientists hope.

In a demonstration before the Royal Anthropological Institute, London, the inventor of the instrument, Dr. K. Wagner, assistant professor of anatomy at the University of Oslo, showed that previous scientific views about the asymmetry of the human skull may be revised.

The difference in size and shape of the two hemispheres of the brain is an important feature of anatomy which has never been completely explained. The interior of the skull cap, which fits neatly over the brain, shows these irregularities.

Dr. Wagner's instrument consists of a metal bar, from the end of which slightly flexible arms project. When inserted within a skull, the adjustable arms give the measurement, which is read directly from a scale on a bar. A small mirror on the instrument enables accurate placing of the arm ends against the bone.

Dr. Wagner told of examining 369 skulls of Norwegians, Lapps, Eskimos, Maoris and Australians. His tentative report is that the typical human skull is asymmetrical by having the left hemisphere longer and the right hemisphere broader. This finding differs from previous scientific reports on Egyption skulls, which were made with calipers and were admittedly unsatisfactory. British investigators, expressing interest in the new device, urged renewed efforts to solve the mysteries of asymmetry.

Wilfred Le Gros Clark, professor of anatomy at St.

Thomas' Hospital, reported researches on asymmetry begun in Borneo fourteen years ago. His studies stress three factors as linked with brain and skull shape. These are right-handedness, distribution of the veins and a characteristic skew which is found in the Chinese brain. Dr. Clark mentioned observing forehead veins in men who had been playing tennis, and finding that in 14 out of 19 men, the last forehead vein on the right was more prominent.

THE UTILIZATION OF AGRICULTURAL BY-PRODUCTS

NEW impetus has been given the nation-wide search for economic means of utilizing agricultural by-products through the allotment of $70,000 from Public Works Administration funds for the erection of a building to house the Agricultural By-Products Laboratory of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, at Iowa State College. Construction of the laboratory will begin at once.

Upon receipt of the appropriation, P. Burke Jacobs, chief of the laboratory, announced the intended amplification of the research work now under way, and the probable addition of several new projects. The present destructive distillation equipment will be enlarged to allow the complete recovery, under factory conditions, of acetic acid, carbon and other by-products from farm wastes. "Activated" carbon, tar oils for uses such as anti-knock motor fuels and insecticides, and methanol for anti-freeze liquids will be produced on a scale sufficient to allow large-scale tests of their possible application.

Fermentation studies involving the production of utilizable pulp or of alpha cellulose, fuel gases, or organic acids will be expanded. This entails the consideration of the whole question of costs of purified cellulose as extracted from farm wastes. A situation may eventually be reached where increasing costs of wood will allow economic utilization of the vast amount of cellulose now produced and wasted annually as farm wastes, for the manufacture of paper, press board, rayon and other valuable uses.

New projects contemplated include the production of fuel briquettes from farm wastes, utilization of feathers from the packing house industry, utilization of glucose and gluten wastes from the refining of corn products, investigation into the improvement of processes for manufacturing paper from straw, improved fermentation processes for the production of fibers from flax and possibly the utilization of creamery wastes.

ITEMS

WHEN the metal lithium is bombarded with ions of the heavy, mass two isotope of hydrogen, deuterium, alpha particles are ejected with a speed considerably greater than swiftest alpha particles from radioactive substances, experiments at Cavendish Laboratory, Cambridge, under the direction of Lord Rutherford have shown. The research shows that a deuterium particle occasionally enters the kernel or nucleus of a lithium atom of mass six and that the nucleus that is formed then breaks up into two alpha particles, which are kernels of helium atoms. These two alpha particles escape in nearly opposite directions. The capture of a particle by a lithium nucleus of mass seven causes a breakup of the system into two alpha particles and a neutron whose maximum energy is equivalent to fifteen million volts.

SIX hundred galactic nebulae, great masses of stars similar to our own Milky Way, have been found by Harvard Observatory in a region where only sixteen were known hitherto. Dr. Harlow Shapley, director of the Harvard Observatory, described this latest accomplishment made with the aid of one of the observatory's new telescopes and explained that the nebulae images were found and counted upon a photographic plate as one of the last Harvard Observatory discoveries of 1933. He was able to report this accomplishment at the time that he was awarded the Rumford medal by the American Academy of Arts and Sciences. The bit of the heavens thus given nearly a forty-fold increase in its known population of galaxies is an area about equal in size to the bowl of the Great Dipper and lying between that constellation and the star group known as the Lynx.

A SUBSTANCE identical with a female sex hormone, theelin, has been obtained from palm nuts by Professor A. Butenandt and Professor H. Jakoby, of the University of Göttingen. Sex hormones, like theelin, are spread throughout the whole animal kingdom from the highest down to the lowest single-celled organisms. Similarly acting substances are also found in plants. It has been known for some time that the plant hormones could stimulate sexual activity in animals and that the animal hormones affected the plant's development, stimulating ripening and blossoming. The reason for this, it appears from the work of Professors Butenandt and Jakoby, is that the sex-stimulating hormone in both plants and animals is the same substance. While the investigation was restricted to palm nuts, it is probable that the sex hormones of all plants is the same.

MITOGENETIC rays, those mysterious and potent rays said to emanate from roots of growing plants and yeast cultures, may exist, but physical proof of their existence is lacking, it appears from the annual report of activities of the U. S. Public Health Service to Congress, made public recently. At the office of field investigations of cancer, in charge of Dr. J. W. Schereschewsky, at Boston, studies designed to demonstrate by physical means the presence or absence of these rays were carried out. In these studies an apparatus for detecting and measuring extremely small quantities of radiation, the so-called "Geiger radiation counter," was used. The sensitivity of this apparatus was determined in absolute units and was found to be at least six times as great as necessary to respond to radiation of the intensity assigned to mitogenetic radiation. Even with this very sensitive detector no rays could be detected from any of the various substances said to be active radiators of mitogenetic rays, the government scientists reported.

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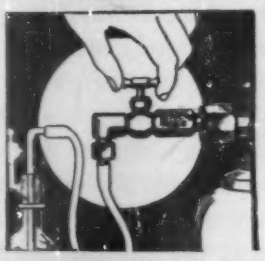

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SCIENCE NEWS

Science Service, Washington, D. C.

THE WEIGHT OF THE NEUTRON

NEW hope of obtaining energy from the atom and convincing proof that the neutron is lighter than its generally accepted mass figure, have resulted from the latest experiments of Professor E. O. Lawrence and his associates working with the unique magnetic "merry-go-round" atom gun at the University of California.

The University of California investigators, having faith in their own previous experiments, have continued to devise new and conclusive proofs that the mass of the neutron is 1.0003. Heretofore the whole scientific world was rather thoroughly convinced that this most important constant had the value 1.006. This higher value was proposed by the discoverer of the neutron, Professor J. Chadwick, of Cambridge, and subsequent work seemed to verify it.

Less than a year ago Professor Lawrence and Drs. Stanley Livingston and M. Henderson working with deutons (nuclei of heavy mass two hydrogen) made by Professor G. N. Lewis found that the deutons apparently split up when bumped hard and gave out more energy than was put in. This could be true only if the neutron were lighter than 1.006.

Such a result was so startling that it was not generally accepted. Physicists offered all possible explanations of how it might be wrong. A further experiment described in *The Physical Review*, however, confirms the earlier result.

Two targets were bombarded with exactly similar protons of about 3,000,000 volts energy accelerated in their atom gun. One target had ordinary hydrogen in it and nothing happened. The other target was just the same, except that heavy mass two isotope (deutons) replaced the ordinary hydrogen. From this target great showers of protons and neutrons were emitted. These often had more energy than the impinging protons. Analysis showed that these results could be explained only if the neutron's mass is less than 1.0003.

The method is so convincing that the conclusions will be accepted everywhere in spite of the jolt they give to preconceived notions about the structures of the nucleus. First, they mean that the beryllium nucleus, the deuton, or heavy isotope of hydrogen nucleus, and the proton are all unstable in the sense that they could break up into parts with explosive violence. They do not and scientists have no notion why.

Some day physicists hope to understand the process and then there will be a chance of obtaining energy from the nucleus. For example, the small difference between 1.006 and 1.0003 means that a pound of heavy hydrogen could give off more heat than the burning of five thousand tons of coal.

Science is still far from such a goal but the nearest approach is in these recent experiments of Professor Lawrence and his coworkers. They have boosted the efficiency of such processes many thousands of times during the past two years. They report that one proton in four thousand is able to disintegrate a deuton into a proton and a neutron and five million volts. The scientific significance of this high yield is much more important than its possible practical application.

EARTHQUAKES IN NORTHERN INDIA

"GROWING PAINS" in the most tremendous mountain system in the world, which is still getting bigger, are probably responsible for the disastrous earthquake in northern India. The whole south slope of the great Asian mountain mass is a very active seismic region, and shakedowns of major intensity, such as always accompany the upfolding of mountain ranges, can be expected there at any time.

It is just short of an even generation since the last major earthquake in that neighborhood. In 1905 occurred the great Kangra quake, which was strongly felt in Simla, summer capital of British India.

Major earthquakes in northern India might have been more frequent in recent decades, but for the relief to internal strains in the earth's crust that must have been afforded by the exceedingly severe Assam quake of 1897, is the opinion of Captain N. H. Heck, of the U. S. Coast and Geodetic Survey. This was the most terrific earthquake recorded in the history of the world. It was felt over two and a quarter million square miles, and caused total destruction of all buildings in an area of 12,500 square miles. The tremors it sent through the earth were visible on lake surfaces in Europe.

Other and more recent earthquakes traceable to growth movements of the Himalaya system have caused widespread death and destruction in Burma. Earthquakes are always most frequent and most severe in regions where the earth's crust is being wrinkled and folded to form mountains. The younger the mountains the greater the seismic activity. Thus, earthquakes have been few and far between in the eastern United States, where the mountain systems are old. The Rockies, which might be classified as mountains in early middle age, are the scene of occasional quakes, while the Pacific coast, with its young and actively growing Coast Range infants, have earthquakes with considerable frequency. The great mountain arc that starts in Alaska and swings down the western shore of the Pacific through Kamchatka, Japan and the Philippines, is one of the most actively growing mountain regions of the world, and also one of the most lively of the earth's earthquake zones.

GYPSUM AS A DRYING AGENT

CALCIUM sulfate, specially prepared by a simple process, joins the ranks of thirsty substances known to chemists as "drying agents." The new preparation is called "soluble anhydrite." It is thus contrasted with common or insoluble anhydrite, a mineral of apparently the same chemical composition, but different behavior.

Professor W. A. Hammond, of Antioch College, Yellow Springs, Ohio, and Professor J. R. Withrow, of Ohio State University, report that calcium, or lime, sulfate, cheaply available and known for hundreds of years, has

surprising powers of taking water away from other material. Common distillery alcohol, normally containing several per cent. of water, at once becomes absolute, or practically 100 per cent., by merely being shaken with the new soluble anhydrite. Numerous other liquids which must be thoroughly dried, or freed from water, before use in chemical processes, may now be desiccated by this treatment.

Most drying agents are either expensive, corrosive or not thorough in action. Soluble anhydrite escapes these three evils, but does have one drawback—it will absorb only six per cent. of its own weight in water. It does not do much, but does that little well. Other agents, such as calcium chloride, absorb greater quantities under favorable circumstances, but will not strip a liquid so thoroughly of water actually held in solution.

Apparently the virtues of anhydrite were overlooked for generations, after plaster-of-Paris chemists had reported that neither the mineral anhydrite nor its artificial imitation made in a furnace would absorb water. Professors Hammond and Withrow now find that the cautious heating of ordinary gypsum, a compound of calcium sulfate with water, for three hours in an oven at 460 degrees Fahrenheit yields a reactive form of the sulfate which drinks in water with great avidity.

Technical measurements reported by the discoverers to the American Chemical Society indicate a possible wide use of the anhydrite particularly by organic chemists, who have frequent need for thoroughly dried alcohols, ethers, esters and similar liquids.

PROPANE AND THE EXTRACTION OF LUBRICANTS

PRACTICALLY all automobile lubricating oils contain a substantial fraction of so-called Pennsylvania oil, according to Dr. Ulric B. Bray, petroleum chemist, in a report to the American Chemical Society meeting at Los Angeles. The difference between good and poor oil lies in the relative amount of the much-prized Pennsylvania-type ingredients. Many supposedly inferior western oils now prove to contain fifty per cent. or more of the good material, and the question naturally has arisen how to get it out.

Unfortunately distillation, the stock-in-trade process of the oil refiner, does not separate good oil from bad, although it does separate light from heavy. Recent researches show that propane, a normal constituent of liquefied natural gas, can be made to turn the trick. This remarkable substance, cheaply available, looks like gasoline, but has a boiling-point of 48 degrees below zero Fahrenheit. It has the ability to dissolve out, or extract, the Pennsylvania type of ingredient, but not the asphalt, paraffin wax and other undesirable components which mar the cheaper lubricants.

Lubricants extracted with propane have the pleasing habit of constancy in viscosity during the process of warming up of a motor. They are thin enough to permit the starter to turn over a cold motor—and at the same time remain sufficiently viscous in a hot motor for proper lubrication.

The new refining method opens wide new resources for manufacture of really good motor oil, since Texas, Oklahoma and California oils, previously thought unsuitable, are available as raw materials. Entirely new and peculiar refining apparatus must be devised, however, to take care of the propane in view of its extremely low boiling point. The whole process will have to be conducted under pressure.

THE FOOD VALUE OF INVERTEBRATES

FOOD and vitamins from starfish and red sponges, among the most abundant, most useless and most unappetizing of all sea life along the Atlantic coast, are possibilities hinted at by researches in the Sterling Chemistry Laboratory of Yale University, under the direction of Professor Treat B. Johnson.

One of the interesting things discovered about starfish is the presence in its tissues of considerable quantities of free amino acids, which are the chemical building-blocks of proteins. In other animals these acids are for the most part bound up in proteins, and before another animal can make use of them it must break the proteins apart by digestion. Just what the scientific significance of uncombined amino acids in starfishes may be, and what practical advantage can be taken of the phenomenon, are points awaiting further investigation.

Red sponges have been found to contain the vegetable pigment carotene, which is the raw material used by animals in making vitamin A. Only red sponges contain this pigment. Getting it out constitutes a terrific laboratory job: it takes a ton of wet sponges to yield a hundredth of a pound of carotene.

One of the things hoped for from the researches is further light on the relationship that may exist between vitamin A, which prevents an eye disease, and vitamin D, preventive of rickets. They are close chemical associates, but it is not yet known whether one is derived from the other, or both from a common source.

Oysters, a more conventional marine food animal, are also being subjected to analytic treatment, especially by Dr. Warner Bergmann, working in a special laboratory at Milford, Connecticut. He states that they contain two hundred times as much iodine, weight for weight, as milk, eggs or beefsteak.

THE TREATMENT OF ARTHRITIS WITH GOLD SALTS

RHEUMATOID arthritis, if treated within two years of its onset, may be cured in 50 per cent. of the cases by injecting small doses of a gold compound into the muscles, a French physician, Dr. Jacques Forestier, of Aix-les-Bains, told members of the Hunterian Society at a special meeting held in London.

Dr. Forestier's report was based on five years' experience with five hundred cases of this type of arthritis. Half of these patients were completely cured and the other half greatly improved, he said. Of patients who had suffered from the disease for more than two years before starting his treatment, one fifth were cured, and nearly two thirds showed great improvement. Dr. Forestier described the case of one woman, thirty-five years old, who had been confined to her room with com-

pletely stiffened joints for thirteen years. After treatment with the gold compound, she was able to resume her profession.

The gold compound which he has found most successful in treating this wide-spread malady is known by the chemical name of aurothiopropanol sulfonate of sodium. It is injected into the muscles of the patients. In severe cases repeated courses of injections of small amounts of the gold salts must be made over a period of eighteen to twenty-four months in order to effect a cure.

The method has been gradually accepted by French physicians and is being gradually adopted by German physicians also. It is often successful in cases of infectious arthritis, but not in another type of the disease, osteoarthritis.

During treatment it is essential to make routine blood tests to determine the progress of the disease and treatment must be continued even after the disappearance of symptoms until one of these tests, the sedimentation test, becomes normal. This latter is a relatively new test which shows the rate at which red blood cells fall in a column of blood in a test-tube.

The poisonous effect of the gold compound is slight provided the patient is free from diabetes, nephritis and liver disorders, and provided smaller doses are given than for the treatment of tuberculosis. The patient to be treated must be free from a tendency to hemorrhage.

ARCHEOLOGICAL DISCOVERIES IN CZECHOSLOVAKIA

WHAT is believed to be the oldest musical instrument in the world has been discovered on the slopes of the Pollau Mountains in Czechoslovakia.

It is a musical pipe made of a lion's tooth. It sounds a signal in the notes of D and G which can still be played perfectly after some 30,000 years.

Professor Karel Absolon, of the Brno University, discoverer of the pipe, claims that the very origin of musical instruments, and painting and sculpture as well, is traced to these mountains.

His excavations, continued through a number of years, have brought to light many objects made by the mammoth hunters of Central Europe. The lion-tooth pipe is his latest find.

The artistic work of this Aurignacian culture is shown by such pieces as the head of a wild horse, admirably modeled. The stone horse's head is identified as copied from the little horse, *Equus ferus*, which was thickly covered with hair and roamed in Europe during the Ice Age. The species was rediscovered only in the eighteen eighties, by a Russian explorer in the Central Asiatic steppe lands. A reindeer head is another art work by the mammoth hunters.

Most striking of the art exhibits is the statue of a mammoth complete. The prehistoric sculptor captured the characteristic form of the shaggy giant, the back drawn upward, its plump and heavy legs, all familiar to science from reconstruction of real mammoth remains.

The ancient hunters made "combination tools," Professor Absalon's collection shows. One three-fold implement is a blunt stiletto at one end, a notched trowel at the other, while from beneath it is a chisel. A saw with serrated teeth is another tool of this Old Stone Age.

ITEMS

THE only known case of an Alaskan glacier advancing was called to the attention of the Geological Society of America at its Chicago meeting, by Dr. Chester K. Wentworth and Louis L. Ray, of Washington University, St. Louis, Missouri. During the past fifteen or twenty years, Dr. Wentworth said, Alaskan glaciers generally have been melting back faster than they have been flowing forward. The net loss had been as much as 170 feet in some glaciers, as little as 20 feet in others. But the Taku glacier alone has been in rapid forward movement. It has advanced 7,600 feet since 1909. The cause of this anomalous advance is a mystery. Dr. Wentworth suggested the possibly of an earthquake's having caused the dumping of a huge quantity of snow on the glacier, perhaps in 1899 or at some time since. But, he added, no wholly satisfactory explanation has been formulated.

A BIRD no bigger than a good-sized bee, found in the Haitian highlands, is described in a new publication just issued by Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution. It is known as the Hispaniolan vervian hummingbird. In spite of its tininess it is quite pugnacious, as indeed most hummingbirds are, and does not hesitate to dart to the attack of birds as big as a mockingbird if it objects to their presence. Among the other remarkable birds found in Haiti, Dr. Wetmore and his companion, Frederick C. Lincoln, of the U. S. Biological Survey, found a species of woodpecker that lives in community "apartment houses" instead of in solitary dwellings, after the fashion of the woodpeckers familiar in the North. They favor trees with hard trunks, and a whole group of them—a dozen pairs or more—will dig their nests out close together. Dr. Wetmore believes that subsequent wetting and rotting of the trunk at this point may result in so weakening it that it will break off readily in a storm.

A ROOSTER without wings is the strange freak of nature recently received by the Smithsonian Institution. It has been given quarters at the National Zoological Park, where it is being studied by Dr. Herbert Friedmann, curator of birds at the U. S. National Museum. Fowls without wings are hatched occasionally, but all hitherto reported have died while still young chicks. The present specimen, a Plymouth Rock, grew to healthy adulthood in the flock of Mrs. Olia Deering, of Rose Hill, Kentucky, who sent it to the Smithsonian Institution. Its parents were normal birds.

IF the meteors that have fallen upon the earth during the past hundred million years were to be evenly spread upon its surface they would form a layer hardly more than one hundredth of an inch in thickness. This is the calculation made by Dr. Harold Jeffreys, F.R.S., of St. John's College, Cambridge, and communicated by him to *Nature*. Dr. Jeffreys states that on the average, in ordinary circumstances, about three meteors are visible per hour at a given place, and that represents meteors that have fallen within a radius of at least 100 kilometers (about sixty miles).

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SCIENCE NEWS

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SOME PAPERS READ AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION

WHILE the universe as a whole may be expanding, as recent astronomical theory contends, the portion of the universe closest to man and the earth, extending for millions upon millions of miles out into space as far as the famous Clouds of Magellan and the Andromeda nebula, is not expanding. This is the conclusion of Dr. Harlow Shapley, director of the Harvard Observatory, announced when he was presented the Rumford Medal of the American Academy of Arts and Sciences. He has studied intensively the region of the cosmos relatively close to us and he finds that there is a local supergalaxy, a sort of universe within a universe, consisting of our own Milky Way system, the two clouds of Magellan, the Andromeda nebula and two companions, and two other external galaxies. This supergalaxy seems to behave as a single unit and it does not show the expansive nature attributed to the universe as a whole by the theory of Abbe Georges Lemaître, the Belgian priest-cosmologist. Dr. Shapley's study has doubled the size of the Large Magellanic Cloud, which is the nearest of the external galaxies and a spectacle of the southern latitude skies for four hundred years, since the time of the world-explorer Magellan, whose name it bears. The dimensions heretofore accepted have been doubled, and Dr. Shapley rates the Large Cloud as not less than twenty thousand light years in diameter. This makes it larger than the average external galaxy, but it is still much smaller than our own system and the great Andromeda nebula. Using photographs made at the Harvard Observatory's southern station in the Orange Free State of South Africa, Dr. Shapley has found that there are several millions of giant and supergiant stars that are of higher candle power than our own sun, some of them ten thousand times as bright. A gigantic mingling of our own Milky Way galaxy with the Large Magellanic Cloud some time in the past, many, many thousands of years ago, may have occurred, Dr. Shapley surmises from irregularities in the cloud. He finds an intimation in the arrangement of newly found star clusters in the cloud that it is a deformed or broken-up spiral and he believes that the disfiguring may have been caused by the passage of the cloud through our Milky Way at a remote past time.

VAST areas on the outskirts of the Great Nebula in the constellation Andromeda, "dark" to our insensitive eye, and "dark" even to the best photographic plates, have been detected by means of a new photoelectric "eye" attached to the hundred-inch reflecting telescope at Mount Wilson. Dr. Joel Stebbins and Dr. Albert E. Whitford, of the observatory, told of their new exploration of the outlying parts of this "island universe" before the meeting of the American Astronomical Society. The "eye" consists of an extremely sensitive photoelectric cell, which causes a minute electric current to flow when light or invisible radiations fall on it. Amplified by means of a suitable vacuum-tube hook-up, this current causes a galvanometer to register its intensity. The investigation began in the dark space outside the great spiral nebula, and the astronomers "felt their way in." Long before they reached a point visible either to the human eye or the photographic plate, the galvanometer was registering strongly. There is evidently enough "dark" material in the suburbs of this nebula, and presumably of others as well, to more than double its diameter. This has an important bearing on the astronomy of the galaxy in which our own solar system is a small unit. Previous measurements have indicated that ours was a bigger mass of stars than others which we can see with our telescopes. But this addition to the size of our neighbors put us on a plane of cosmic equality again.

SEXTANTS and binoculars used by the Navy and on ships at sea can be improved for observation under certain light conditions by attaching to them polarizing prisms, Dr. E. O. Hulburt, of the Naval Research Laboratory, told the American Physical Society. Such a device admits light that vibrates in only one direction. It has long been known, Dr. Hulburt said, that the light of the sea and of the sky is a mixture of plane polarized and unpolarized light. He found that a polarizing prism properly oriented would darken the sea relative to the sky, reduce the brilliance of the sun path and render the horizon more distinct. In bright weather it increased the visibility of objects against the sea background. This is expected to make observations at sea more accurate and easier.

RADIOACTIVE water, captured by geologists in wells dug by farmers in Michigan, disclosed the existence of a fault or crack in the earth's deep rocks, although it was masked by a thick overlying layer of earth, according to Professor Alfred C. Lane and Dr. W. R. Bennett, of Tufts College. Water samples, collected and rushed to Purdue University for analysis, showed varying degrees of radioactivity—the closer to the fault the wells, the more active the waters. This was because radioactive substances from deeper within the earth's crust were rising through the crack and charging the water. Professor Lane also called particular attention of chemists and physicists to the necessity for knowing the geological sources of the materials they work with in the laboratory. Many elements are now known to exist in several varieties, or "isotopes," practically identical in their chemical behavior, but differing in atomic mass or weight. There is, for example, a good deal of "light lead" from Canada, which is one atomic unit lighter than most lead that comes to market; and lead salts made from it may get the careful calculations of scientists a little off unless they know where it comes from and figure accordingly. Similarly, there are different atomic weights of naturally occurring calcium from different sources. It is said to be of considerable importance both to the chemist and

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the physicist as well as to the geologist that they should know the source of the material that they are using and not simply take something out of a bottle.

WHEN the sun is pouring out its light and heat most energetically the weather in parts of the world may be growing colder and stormier instead of warmer. An explanation for this climatological paradox was offered before the meeting of the American Meteorological Society, by H. H. Clayton, of Canton, Mass., a well-known student of weather science. Changes in weather trends, and in the mutual relationships between weather conditions in different parts of the world, are to be accounted for on the basis of shifts in what Mr. Clayton calls "centers of action"—veritable weather factories that hover persistently above certain spots on the globe. There is a tropical center of action over the South Atlantic between tropical Africa and the mouth of the Amazon River, and another over the Indian Ocean. Similar centers of action exist in the temperate zones. If these centers stood still things would be much easier for meteorological science; but they don't, and it is in their shifts, as correlated with fluctuations in solar radiation, and in the regular seasonal changes in the sun's position that Mr. Clayton sees the clue to much that has hitherto been baffling in weather studies, and perhaps a key for the eventual solution of the much-probed riddle of long-range forecasting. When solar radiation increases, the centers of action in high latitudes move farther north and increase in intensity, that is, the pressure over cold regions in those latitudes becomes abnormally high and the temperature falls, while simultaneously the belts of low pressure in equatorial regions widen and develop centers of low pressure in middle latitudes.

H. W. CLOUGH, of Arcade, N. Y., discussed the weather of the present century, past and prospective. Four long cycles of solar activity have been recognized; their lengths are 37, 83, 300 and 1,400 years. Similar cycles have been traced in meteorological and other terrestrial conditions. The 37-year cycle culminated recently in the extraordinarily mild winters that have been experienced, as well as in the severe droughts of recent summers. The 83-year cycle brought its last spell of mild winters about 1860 and is due to repeat in 1940. The present tendency toward mild winters may be intensified by the partial overlaps of the two cycles. The longer, 300-year cycle reached its mild climax last in 1725 and is due for another one about the end of the present century. Finally, the last minimum epoch of the 1,400-year period may be placed at around 650 A. D., with the next to be expected in the middle of the twenty-first century.

GLANDS are not all-powerful in determining the course and limits of development of human and animal bodies. Hereditary factors in the other tissues have their own say about the matter, Professor C. R. Stockard, of Cornell University Medical School, New York City, indicated in an address prepared for the Boston meeting. Admitting the great influence of the various ductless glands on the normal development of the body, and in causing gigantism, dwarfism and even abnormal mental conditions when their own growth or secretions are not normal, the speaker called for certain qualifications in doctrine: The internal secretions are so powerful in their effects that many investigators have been led too far in thinking them the actual determiners of the pattern for size and form. Only recently has the question been asked whether these strange glandular secretions are capable of calling forth the same effects on all individuals; or whether something deeper in the individual's constitution may not influence the manner in which it reacts to the secretions. In other words, is the reaction of tissues of the body to a peculiar internal secretion a function of the composition of the tissues as well as the quality of the secretions? In order thoroughly to answer such a question it becomes necessary to control and modify the hereditary composition of the tissue in animal types which exhibit growth reactions of the kind commonly interpreted as being due to peculiar secretory quality. The many peculiar structural types exhibited among the fancy dog breeds are exactly comparable to deformities attributed to diseased internal secretions in man. Crossing or hybridizing these dogs in definite ways makes it possible to break up the structural complexes and recombine them in such manner as clearly to test whether the hereditary composition of the tissues is capable of regulating or determining the responses to the internal secretions. The indications are that the tissue constitution determines its mode of response to any modifications in the secretion. Thus gigantism and dwarfism, and many other such deviations from the usual pattern, are primarily hereditary or genetic in origin and only secondarily associated with modifications in the internal secretions.

A PLEA to spare a little time from the study of cosmic rays and relativity for the study of the chemistry of the body was made by Professor Lafayette B. Mendel, of Yale University. He called attention to many points about the vitamins, the gland secretions and the composition of foods that still require investigation. Milk, for instance, is one of the best studied of foods, yet its chemical composition is not accurately known even today. The text-books state that it contains 4 per cent. of protein, but this figure is only an estimate, based on the accurate determination of nitrogen. Furthermore, it includes a number of nitrogen compounds that are not proteins, and while these are only present in minute amounts, they may have physiological value. Sometimes the milk is analyzed more discriminatingly so that the protein item can be subdivided into casein and other milk proteins. These different proteins undoubtedly play somewhat different rôles in nourishing the body and they are distributed in unlike proportion in milks of different species of animals as well as in foods prepared from such milks. The figure given for the percentage of fat contained in milk really represents the percentage weight of the milk components that can be dissolved in certain organic solvents, notably ether. Most of these compounds are true fats, but a considerable percentage of the ether extract may be made up of other types of complex fatty derivatives which are not true fats. Since

The Journal of General Physiology

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there is a wide-spread belief that certain fatty acids are indispensable in nutrition, it seems desirable for the chemist to find out more details about the fatty constituents of the foods we eat. The fact that cow's milk contains citric acid is rarely referred to, and its significance is unknown. Here is another problem for research, and Professor Mendel indicated many others in his address.

ANTHROPOLOGISTS attending scientific sessions recently held in Boston were urged to act speedily to agree upon principles governing a standard table for child growth studies. Professor T. Wingate Todd, of Western Reserve University, said that tables setting standard weights for given heights in children do not meet the needs of those studying child growth. He described measurements of Sicilian-born school children in Cleveland public schools, showing that maturity needs to be considered no less than weight and height. The Sicilian children were, on the average, only as tall as American children a year younger than themselves. They were not malnourished, however, for despite their smaller build they were only seven months behind Americans in weight. When x-ray studies of skeletal development were made, the Sicilian boys were found to be four months behind American boys in bodily maturity, and the Sicilian girls were only two months behind American girls. Investigations of Negro children gave comparable results. And in further studies of children from under-privileged homes it was found that while these children were not so tall and heavy as children in economically secure homes, yet the under-privileged children showed neither malnourishment nor under-development. Principles for constructing a reliable table upon which samples of child population can be compared were outlined. Children of each age group should be of identical physical maturity as well as identical age. The socio-economic level should be approximately identical in a series. The date of the sample must be defined, for successive generations have different diet and different social environments. Sexes and human stocks must be segregated. And the samples should be uniform in geographical origin.

THE study of the organization of human nature by observation of the interrelations of the millions of possible combinations of traits and tendencies is an endless task, according to Dr. Edward L. Thorndike, of Teachers College, Columbia University. The organization of human nature may be studied in the genes (the carriers of heredity) and in the unlearned tendencies which are our only present clew to the genes for mental traits. It may be studied in the habits, tendencies, abilities, and so on, into which the original unlearned tendencies are transformed. But these, Dr. Thorndike explained, consist of millions of probabilities that such and such situations will bring out such and such responses of thought, feeling or action. All these things are hard to measure, and there is even dispute as to what the unlearned tendencies are. So it has been customary to simplify the task by assuming the existence of realities in human character to correspond to what are commonly spoken of as leadership, inventiveness, memory, imagination, reasoning, originality, honesty, perseverance, and so on. This simplification is not without danger from the point of view of the scientific man.

Do exceptionally bright children keep their intellectual advantage over their fellows after they are grown? The answer would seem to be in the negative, to judge from an investigation being conducted at the Graduate School of Education of Harvard University. A report of progress of this investigation was made by Professor Edward A. Lincoln. The intelligence of superior pupils, as measured with the Stanford-Binet test, drops substantially during a period of five or more years, and girls lose more than boys. The pupils who were re-examined after a lapse of only two years did not show so great a loss; thus apparently it does not occur early in the school career.

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SOME PAPERS READ AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FROM the pituitary gland located at the base of the brain come two hormones which produce opposite effects on the sex glands of mature fowls, it appears from the report of Drs. Oscar Riddle and his associates, Ernest L. Lahr and Dr. Robert W. Bates, of the Carnegie Institution of Washington. One of these hormones has for some time been known to cause rapid and premature growth in the sex glands of young animals. Dr. Riddle and associates have now found that small amounts of this same hormone cause enlargement of the ovaries of mature hens, also. Another hormone of the many produced by the pituitary gland, the one which stimulates milk production in mammals, has the reverse effect on the ovaries of mature fowls, causing a marked decrease in their size. The same opposite effect of these two hormones was observed on the sex glands of adult doves, both male and female. These observations reinforce other evidence previously obtained, indicating that not one but two hormones of the anterior pituitary are concerned in regulating the size and activity of the sex glands and that the normal adult size of these glands can be increased or decreased by giving the appropriate hormone.

BABIES are not just little men and little women, and when they grow up the process is one of development and transformation as well as of growth. These conclusions, reached as a result of careful anthropological studies, were reported by Dr. Charles B. Davenport, director of the department of genetics, Carnegie Institution of Washington. The fact is that the infant is not at all merely a small man, but the two stages are remarkably unlike; strictly, the infant does not merely grow into a man, it *develops* into a man. The head end of a baby's body is more developed than the tail end. A baby's head is nearly two thirds as big around as an adult's, but the lower part of his body and his legs seem almost rudimentary compared with those of an adult. His shoulders, while relatively large, are quite different in form from those of an adult. As the baby grows, the shape of his shoulders changes so as to free his arms for the most varied movements, and the main wings of his pelvis undergo great development to provide for the muscles that hold the human erect. His chest changes from a nearly circular cylinder to the flatter, broader adult shape. His legs grow relatively faster than his trunk, first the thigh, then the lower leg, and then the thigh takes another spurt, so that the child is transformed from a romping to a walking animal. At the same time his foot is transformed from an ape-like type to one better fitted for walking on two feet.

PLANTS and animals living on the bottom of the sea along the coast have as complex relationships with each other as folks in cities, or men, animals, trees and lesser plants in the country. Professor W. C. Allee, of the University of Chicago, described some of their societies of the deep and outlined some of the problems of their "sea-sociology." Sometimes an otherwise peaceful community of animals, as oysters or other shellfish, will be domineered over by devouring starfishes and their relatives—marine racketeers. Sometimes a given area will be so thoroughly burrowed by sea worms that nothing else can live there—rough analogy with the incoming of groups of foreigners considered "undesirable" by other dwellers in an urban region. Sometimes physical causes, such as the incoming of too much fresh water or drifting silt or sand, will cause radical changes in the subsurface population. Even earthquakes, changing the level of the sea bottom and hence the light intensity, oxygen concentration and other factors, affect the course of life "in the waters that are under the earth." So complex are the relations of the living things with each other and with their non-living environment that Professor Allee suggested an almost equally complex name to indicate them: "geo-bio-ecology."

A SIMPLE wick-like rod that can be depended on to keep your plants watered with a minimum of attention from yourself was described by Professor B. E. Livingston, of the Johns Hopkins University. The "wick" consists of an exceedingly fine-grained artificial filtering material which resembles a very porous sandstone. One end extends upward a couple of inches through an opening in the bottom of the vessel containing the growing plant, the other is immersed in a reservoir of water. The wick carries water up into the pot, where the soil tends to settle firmly against its upper end, maintaining a good capillary contact. Plants can be kept growing indefinitely in this way, the only attention necessary being an occasional refilling of the reservoir.

THOUSANDS of growing root tips have been kept alive and increasing rapidly for over a year, without any attachment to their parent plants, and fed only from an artificial liquid medium, at the Rockefeller Institute for Medical Research, New York. The experiment was described by Dr. P. R. White, before the meeting of the American Society of Plant Physiologists. The roots used were those of tomato plants. The growing tips were cut off and placed in the nutrient liquid, where they continued to increase and multiply in a manner reminiscent of the famous chicken-heart tissue culture started at the same institution many years ago. One of these tomato-root isolations, Dr. White reported, has produced approximately 20,000 growing points, from an initial fragment less than half an inch long. The ratio of the original bit of material to the resultant growth is expressed by the fraction written as 1 over 10 followed by nineteen zeros, so that there is no doubt that the new growth was made by the roots out of the material present in the liquid medium.

EVIDENCE that the invisible, filter-passing virus that causes mosaic disease in tobacco is concentrated in the living protoplasm of the cells, and not in the watery contents, or cell sap, has been obtained by Professor B. M. Duggar and Dr. L. G. Livingston, of the University of Wisconsin, who reported on their researches before the meeting of the Botanical Society of America. They used a special apparatus with microscopically slender hollow points, to penetrate certain large hair-cells on the surface of tobacco leaves and extract various parts of their contents—an almost incredibly delicate operation. The virus seemed not only to be concentrated in the protoplasm, but to be especially strong when the cells contained special structures known as "inclusion bodies," which can often be demonstrated when the disease is present. It is suggested that the inclusion bodies at least accompany the development of the virus agency in high concentration. Clear demonstration was obtained that the inclusions are fragile structures, readily breaking into granules when touched with the micropipette.

LOCO-WEED, prime trouble-maker to western horses and cattle, is poisonous to much smaller animals as well, according to a report presented before the entomologists. G. H. Vansell and W. G. Watkins, of the U. S. Bureau of Entomology, working at Davis, Calif., told how they have found dead and dying bees in and near the flowers of the spotted loco, one of the more abundant and poisonous species of the weed in certain parts of Nevada. Before the death of the bees was traced to this poisonous plant, it was blamed on a new and mysterious disease, which discouraged many of the Nevada bee-keepers and caused others to move their apiaries out of the region. Loco poisoning of bees, Messrs. Vansell and Watkins found, is most common after the first cutting of the alfalfa crop and before the second growth of this principal honey plant produced a new crop of flowers, especially if sweet clover is scarce and the loco-weed plentiful. Sometimes weather conditions cause a scarcity in the loco-weed, after which the bees do not die off so rapidly.

ITEMS

SUN-SPOTS of the old cycle which is now dying still persist in passing across the face of the sun. Astronomers of the Carnegie Institution's Mount Wilson Observatory report that a group of sun-spots containing from five to sixteen individual spots has been visible on the sun's disc during the past few days. The first sun-spot of the new cycle was seen on October 10. Astronomers can tell whether the great disturbances in the atmosphere of the sun that constitute sun-spots are of the old or new cycle by their magnetic polarity. The magnetic orientation of the spots changes at the time of sun-spot minimum, which is occurring now. The persistence of spots of the old cycle after the appearance of spots of the new cycle is not unusual.

GAMMA ferric oxide, which is chemically like common iron rust but physically unlike it because it responds to the pull of a magnet, is being used at Yale University in the study of the makeup and migrations of blood cells. When it is injected into the blood stream, it is promptly taken up by the corpuscles, and its subsequent location, learned by magnetic search, shows where iron is stored in the body. Among the other things being investigated by this new method is the function of certain hitherto puzzling cells of the liver. Gamma ferric oxide has long been known as a chemical curiosity, but it was not until Dr. Oskar Baudisch, a research fellow working with Professor Treat B. Johnson, began making it up in quantities sufficient for research purposes that its possibilities as a scientific tool began to be appreciated.

A HUGE airplane photographic map, 40 by 24 feet, of the Navajo and Zuni Indian lands in New Mexico, Arizona and Utah has been contracted for by the Department of the Interior. It is to be used as a basis for the better regulation of grazing practises, which have already gone to severely damaging excess in many small areas and a few large ones. Airplanes making the photographs will fly at an altitude of over 20,000 feet, taking more than 4,500 individual photographs with a special four-lens camera. The separate pictures will be fitted together into a single mosaic map. Total cost of the work will be about $77,000; but if the work were done by ground parties it would cost more than $500,000.

TEMPERATURE inversion, that is, warmer air as one goes higher, is a more common phenomenon in winter than has been suspected, air-line pilots have been discovering lately. On one day recently, when the ground temperature was only 10 degrees above zero, pilots encountered a temperature of 40 degrees at 4,500 feet. On the same day, pilots leaving an 8-degree temperature at the Cheyenne, Wyoming, airport found a 36-degree temperature at an elevation of 9,000 feet above sea-level. Reports on air temperature and other weather conditions are given by the pilots every twenty minutes, and are coordinated with information collected and supplied by the far-flung airway weather observation system of the U. S. Weather Bureau.

Die Umschau, German popular science weekly, presents in brief summary form a comparison of the products of the U. S. A. and the U. S. S. R. The Soviet Union with approximately the same population as the United States and 50 per cent. greater area, produces 20 per cent. of the world's breadstuffs and 80 per cent. of the world's flax. The U. S. A. produces only half as much grain and practically no flax. In other products the United States leads. Figures are: Cotton, U. S. A., 60 per cent. of the world's supply, U. S. S. R., 5 per cent.; coal, U. S. A., 35 per cent., U. S. S. R., 5 per cent.; petroleum, U. S. A., 60 per cent., U. S. S. R., 10 per cent.; pig-iron, U. S. A., 25 per cent., U. S. S. R., 15 per cent. The United States produces about 80 per cent. of the world's automobiles, while so few are manufactured in Russia at present that they hardly figure in the percentage column at all. In timber production, the two countries are on an even footing, each cutting 15 per cent. of the world's annual supply.

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SCIENCE NEWS

Science Service, Washington, D. C.

ARTIFICIAL PRODUCTION OF RADIOACTIVITY

ARTIFICIAL radioactivity has been produced for the first time by Professor F. Joliot and Mme. Irene Curie-Joliot, the famous Paris physicists who are husband and wife. Mme. Curie-Joliot is daughter of the discoverers of radium. Never before has radioactivity been created by an external cause.

This achievement has stirred interest at the famous Cavendish Laboratory, Cambridge, where experiments attempting confirmation are in progress. There is hope that through artificial radioactivity medically useful radiation will be produced.

The artificial radioactivity produced by the Joliots consists of obtaining positrons or positive electrons from bombardment of boron with alpha particles. The important fact is that the activity or disintegration produced continues for many minutes after the bombardment is stopped. Boron decays exponentially to thirty per cent. in fifteen minutes. Similarly, artificial radioactivity proceeds in aluminum and magnesium. The decay period in aluminum is four minutes.

Lord Rutherford stated that "It is remarkable that the life of the unstable atom produced is as long as it is. We do not know whether the atoms so far made artificially radioactive are typical or whether other unstable atoms which may be produced will have a longer or shorter life.

"The discovery of the Joliots shows how little we really know about radioactivity."

The mechanism of the artificial radioactivity of boron is interpreted to mean that a boron atom and the helium nucleus or alpha particle unite to form a neutron and an unstable nitrogen atom of weight thirteen which in turn changes to a carbon atom of weight thirteen with the release of a positron. The positron is the new particle discovered in 1932 at Pasadena, California.

M. and Mme. Joliot made experiments that were an important step toward the discovery of the neutron at Cambridge, England, in 1932.

While transmutations and disintegrations of matter have been accomplished in many ways before, the propressive and continuing disintegrations of atoms have not heretofore been accomplished or instigated artificially. Natural radioactivity has been proved, since its discovery before the turn of the century, to be a property of many atoms.

Uranium and radium are typical elements that are naturally radioactive. Some of the unstable atoms naturally radioactive have an extremely long life. The activity of radium only falls to half its value in 1600 years. Other spontaneous changes require time measured in seconds, thus being similar in time period to the artificial radioactivity discovered.

"POISON WATER" OF THE BLACK SEA

CARCASSES of beasts that died a hundred thousand years ago or more still choke the bottom of a large part of the Black Sea, and still poison the water there with the noisome products of their decay. This explanation of the Black Sea's 200,000 square miles of "poison water" was offered by Professor Reginald A. Daly, of Harvard University, who delivered the Sillimsn lectures at Yale University.

During the last great Ice Age, Professor Daly explained, so much water was locked up in the great glacial sheets that the sea-level was materially reduced. The Black Sea was thus filled with fresh water, and the overflow river of this enormous lake cut the valley now represented by the Bosphorus and Dardanelles straits. When the general sea-level rose again, the salt Mediterranean water entered the fresh water basin and killed its fresh-water animals. The decay of their carcasses poisoned the Black Sea water, from the bottom at the depth of 110 fathoms or 200 meters up to the 90 fathom or 150 meter level.

"Through that great thickness, a half million square kilometers of water remain poisoned to this day. The Glacial lowering of general sea-level laid bare wide belts of the continental shelves, now bounded by the 40 fathom line. Those strips of new land were several hundreds of thousands of miles in total length and up to 100 or more miles in width. Across the temporary lands the rivers were extended and there cut channels in the shelf sediments.

"An illustration is that of the North Sea area, where the floor of that shallow sea emerged. The Dogger Bank became dry, and it remained dry long enough to win covering peat bogs, fragments of which have been dredged up by fishermen from depths of 40 meters. Elsewhere on this new land forests grew. Fishes now swim over the tree trunks, drowned by the last upswing of ocean level. Recently tusks of mammoths have been dredged up from the bottom of the North Sea. Across the temporary land, the Rhine River was lengthened by about 200 miles, and it gained the drainage of the Thames River.

"Another important result of the lowering of the sea-level was the conversion of wide but relatively shallow straits into dry land, with the formation of land bridges between continent and continent, and between continent and island. Thus, for many thousands of years land animals could walk, migrate between Borneo and Sumatra; between Tasmania and Australia; between Ceylon and India; between Asia and America, at Bering Strait; and between many a West Indian island and its neighbor."

THE VELOCITY OF SOUND

SOUND travels 1,087.13 feet per second. This new and highly precise value for the velocity of sound has been computed by Dr. Dayton C. Miller, of the Case School of Applied Science, using data obtained as a result of big gun firing at Sandy Hook just after the close of the World War. Because he has been engaged upon his ether drift experiments, Dr. Miller did not find time to compute his experiments until recently.

The new value, which is for standard conditions, in free air, at the freezing point (0 degrees Centigrade), is near the mean of values of other experiments, the recognized velocity in text-books now being 1,088 feet per second. This means that sound travels a little over a fifth of a mile in a second. The old trick of finding the distance of a lightning flash by counting seconds until thunder is heard, then dividing by five to obtain the distance in miles, is still useful.

An accurately surveyed base of about four miles in length was available to Dr. Miller. The source of sound was the discharge of a large gun at the Sandy Hook Proving Ground. Six listening stations were placed along the course, the first one being about 100 feet from the gun, and the last one four miles away. At each station was a microphone, similar to those used in radio studios. Each microphone was connected by an electric circuit to a recording galvanometer which made a photographic record of the time of the arrival of the sound at the corresponding station. The galvanometer was of the type known as a string galvanometer, which is used in laboratories for various purposes, one such use being the recording of the sounds from the heart beats in medical researches. Meteorological observations for temperature, humidity, barometric pressure, and the velocity and direction of the wind were made at both ends of the course and at two intermediate stations. Seventy-one sets of records were obtained.

THE USE OF BLOOD TESTS IN ANTHROPOLOGY

EXTENSIVE blood tests carried out on Indians of British Columbia by Professor R. Ruggles Gates, of King's College, London, and Dr. G. F. Darby, bring fresh evidence showing close relationship of the American Indians to certain tribes found mainly on islands of the Siberian coast, such as the Giliaks of Sakhalin.

Investigators differentiate four main blood types called A, B, O and AB. The importance of these blood types was made evident during medical operations involving blood transfusion, since serious consequences or even death would result if blood of an individual of type A were transfused into an individual of type B. Type O will mix with either A or B, but A and B if mixed together will cause "clumping" or coagulation. A simple test with a single drop of blood quickly determines the blood-group to which a person belongs.

Practically all pure-blood American Indians of various tribes previously tested were found to belong to the blood-group O. In this they differ from Mongolian peoples on the mainland of Asia and Japan, who have a high proportion of B type.

Haida, Tsimshian, and certain other Indian tribes of British Columbia, have been considered by anthropologists to be more like Mongols in appearance than other American Indians. Professor Gates and Dr. Darby now show that in blood these tribes belong practically all to group O. Out of 300 individuals tested, only two were B and 12.7 per cent. A. And most of the latter were clearly of mixed origin. Thus, the Mongol-like Indians of Canada's northwest are found different in blood type from the mainland Asiatics, but like certain tribes of the Siberian coast and Sakhalin Island.

These findings support the view of Dr. Aleš Hrdlička, of the Smithsonian Institution, who has shown that various racial remnants in northern and eastern Asia and neighboring islands resemble the Indians so strongly as to be often indistinguishable from them in appearance. Such are the Giliaks and Samoyeds.

It would be highly desirable, Professor Gates says, to determine the blood characteristics of all such tribes, before mixed marriages make it impossible to determine exactly their racial origin.

THE RECENT COLD WAVE

THE cold weather carrying "highs" that come from the Arctic have affected particularly the northeastern part of the United States and the weather of the nation has been distorted. As a result the eastern section of the country from Richmond northward has had some of the most frigid weather in its history. It is as though this area had been shifted northward into the Canadian province of Quebec.

The great masses of air with high barometric pressure, known to weather men as "highs," have their origin in the Arctic basin. When this area gets too full of cold air, it flows over much like water from a gigantic bathtub. And like water the highs flow out by the easiest route.

Last year, and usually, the cold has spilled down the narrow valley of the Mackenzie River east of Alaska and southward through Canada along the slope of the Rockies. Montana and Wyoming have felt the blasts of the frigid weather from the Arctic. But this year the frigid "highs" seem to have been unable to find a way out of the Arctic by their usual route and they have pushed on farther eastward and swept southward over the Hudson Bay region to spread record low temperatures over the area around the Great Lakes and in northeastern United States. The Arctic cold air arrived without having spent itself on the northern tier of middle western states and it is colder and fiercer than usual.

As a result of this Hudson Bay trek of the cold air and its avoidance of its last year's route farther west, Montana and Wyoming have had unseasonable heat. In the west it is as though Texas had been transported to the northern limits of the United States. Last year Yellowstone Park registered the all-time low for continental United States cold, minus 66 degrees. This year in Montana and Wyoming there have been days upon days when overcoats were not needed.

The high pressure areas that arrive *via* Hudson Bay vary their paths more than cold waves that enter this country farther to the west. It is more difficult to tell just where they are going to land their frigid burden. New temperature lows were registered in the North Atlantic and Middle Atlantic states as a result of the unusual invasion of Arctic cold. Farther south, well down in Dixie, there was fairly warm weather as usual.

TWO-YEAR PROTECTION AGAINST YELLOW FEVER

MISSIONARIES, government officials and scientists whose work takes them into regions where mosquitoes carrying yellow fever may bite them are now being adequately protected against this toll-taking disease.

For two years investigators working at the Rockefeller Institute for Medical Research under the leadership of Dr. W. A. Sawyer, have applied practically their vaccination technique. Yellow fever virus made safer by at least a hundred passages through white mice is used. Along with the weakened virus human blood from those who have had the disease or have been vaccinated is injected without bad effects. There results an active immunity similar to that which is caused by an actual attack of the disease.

Yellow fever has martyred those who attempted to conquer it. In Africa Drs. Hideyo Noguchi, Adrian Stokes, William Alexander Young and Theodore B. Young died. In Brazil Dr. Paul Lewis died. To-day every Rockefeller scientist in New York, in Africa or in Brazil engaged in the fight is protected by the serum developed by Dr. Sawyer and his associates, Drs. S. F. Kitchen and W. Lloyd.

When in 1931 vaccination against yellow fever was announced to the medical world at a meeting in Philadelphia, it was not known how long the immunity caused by inoculations with immune blood serum would last. Experience has shown it to be exceedingly efficient. Protection lasts at least two years.

Now efforts are being centered upon making the injections less difficult and less costly in human blood. It it not yet practical to protect a whole population against yellow fever, but those most in danger can with safety do their work in dangerous areas.

The Pasteur Institute in Paris has used in its yellow fever vaccinations the blood of immunized horses.

ITEMS

A NEW method of concentrating the double-weight or heavy hydrogen, the essential constituent of heavy-water from which remarkable developments are expected, is reported in *Nature*, by Drs. A. and L. Farkas, expatriate German chemists now working in the Colloidal Laboratory of the University of Cambridge. The new method is chemical and consists in dissolving metals such as zinc in a dilute solution of sulfuric acid. Under proper conditions the lighter or ordinary hydrogen is displaced faster than the double weight variety, in the ratio of four to one, so that the liquid becomes richer in the heavier or double weight variety of hydrogen.

ALL present astronomers or those who will study the far-flung universe during the next 2,000 to 3,000 years will have only light that is already within the Milky Way to aid them. So immense is the universe, Dr. Harlow Shapley, director of Harvard Observatory, explained in a lecture at New York University on "Time," that even light speeding 186,000 miles per second travels only a very short distance, astronomically speaking, in what seem to be long periods of time from the human standpoint. Within the next year Harvard telescopes will make a thousand photographs of external galaxies, so distant that it takes light a million years to travel from them to earth. The photographs will be made by the "flux of energy" or light that is already far this side of our nearest star.

A NEW type of direction-finder, incorporating a cathode-ray oscillograph, has been devised by L. H. Bainbridge Bell, of the Government Radio Research Station at Slough, Buckinghamshire. It shows the bearing, course and approximate distance of all large shipping within a distance of ten miles, provided that the ships are sending out the signals required by the new system. The instrument has a dial marked with the points of the compass. Whenever signals are received bright green arrows appear behind the dial. The direction of each arrow gives the bearing of the corresponding ship and its thickness indicates her distance. If the system is internationally adopted all fogbound ships will send out every twenty seconds a signal consisting of a Morse "dot," the signal itself lasting only a thousandth of a second, so as to reduce interference to the minimum. The signals are received on two fixed loop-aerials, mutually perpendicular, which are connected to electrically similar amplifiers. The outputs from these amplifiers, at the original radio frequency, are applied to the two pairs of deflecting plates in a cathode-ray oscillograph. The screen of the oscillograph forms the indicating dial of the instrument.

GRAND ISLE in Lake Superior, once famous for its white deer herd, again has an albino deer and residents of the vicinity hope the unique herd is coming back. For several years none of the white deer were seen. The one sighted this year has led local residents to believe that the albino strain continued through the herd, to crop out again this season in an all-white offspring, and perhaps to presage another white herd.

SPICES and condiments in moderate amounts really help digestion by stimulating part of the digestive apparatus to greater activity. Scientific evidence of this has been reported by Drs. E. v. Kokas and G. v. Luchàny at the Stefan Tisza Institute of the University at Debrecen, Hungary. The research, it is claimed, shows that spices in dilute solutions, as they are found in rather spicy meals, actually increase the activity of the villi. These are microscopic protuberances of the mucous membrane of part of the digestive tract and have an important influence on the speed and completeness of food absorption. Increasing their activity favors the passage of foodstuffs from the digestive tract into the body fluids.

METEOR showers in Central Europe will in future be observed from airplanes flying high above the mist and clouds which often blot out the sky in November, when the Leonids appear. The Government of Czechoslovakia has agreed to put at the disposal of the Astronomical University of Prague a specially adapted airplane with an unlimited field of view, for this purpose.

SCIENCE NEWS

Science Service, Washington, D. C.

ULTRA-SHORT RADIO WAVES

DRS. C. E. CLEETON and N. H. Williams, of the University of Michigan, are using the shortest radio waves ever produced by radio tubes. These radio waves are less than a half inch long, as compared to the previous low of well over an inch and to the commonly used radio waves of about 1,500 feet.

The waves are produced by electrical oscillations inside a tiny vacuum tube. The anodes or positive plates of the tube are made from graphite cylinders only three tenths of an inch in diameter. The length of the radio waves produced by the tube depends upon the time it takes the electrons to travel from the filament in the center to the inner walls of the cylinder.

The whole vacuum tube is placed in a strong magnetic field, which also influences the wave-length of the waves produced. The stronger the magnetic field, the shorter the waves.

The lengths of these ultra-short radio waves were measured by reflecting them from two brass mirrors, three feet in diameter, to concentrate the energy, and spreading them out in a spectrum by means of a grating or set of finely ruled lines on a polished surface. The waves, after being focussed by the second mirror, fell on a crystal detector that amplified their electrical energy.

Perhaps the most striking thing about this experiment is the partial closing of the gap between the far infra-red rays and the shortest radio waves. This gap has so far been the most difficult for the experimenter to close and this advance has decreased the radio waves by at least two octaves on a frequency scale.

The production of these ultra-short waves was but a part of the result of the experiment. The waves were passed through a rubberized cloth bag full of ammonia gas which absorbed a certain wave-length of the band of waves to an abnormal degree. From measurements on this absorbed wave-length it was possible to show that the ammonia molecule has an apparent diameter of about 3½ hundred millionths of an inch (0.000000035 inch). That is, 100,000,000 ammonia molecules in a chain would be only 3½ inches long.

METEORS AND RADIO RECEPTION

During the November shower of Leonid meteors, Drs. R. Minohara and Y. Ito, of the Naval Experiment and Research Establishment in Tokyo who were at work on a series of experiments for determining the height of the Kennelly-Heaviside Layer, the radio reflecting area of the upper atmosphere, made observations upon the effect of meteors on the transmission of radio signals.

Meteors speed through the upper air at the rate of 26 miles (42 kilometers) a second or more, the investigators stated in a report to the Radio Research Committee of the National Research Council of Japan. The friction caused by these objects hurtling through the atmosphere produces ionization in their pathways before the meteors are heated to incandescence and become visible. Small meteors serve to ionize the upper atmosphere, while the larger ones penetrate to and ionize relatively lower altitudes.

Air or any other substance is said to be ionized when through any cause the molecules, atoms or other particles of which it is composed have electrons knocked out of them, leaving them positively charged.

Even in the day-time, meteors affect radio waves, causing irregularities in reception. Those of relatively long wave-lengths are affected comparatively little, because long wave-lengths are reflected at the lower surface of the sun-ionized region of the atmosphere. Shorter waves penetrate farther and may be reflected by "ion clouds" formed by the meteors or by an upper ionized layer formed by the smaller meteors.

At night, when the ionizing effect of the sun is not so great, the effect of the meteors is relatively greater.

THE TOTAL ECLIPSE OF THE SUN

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DR. WILLI M. COHN, leader of the American Eclipse Expedition, sends the following statement by radio from Losap Island. "Perfect conditions and completion of my observing program made entirely successful the St. Valentine's Day total solar eclipse which I observed from this little coral island to-day. The sky in the vicinity of the sun was perfectly clear. There was no wind. The "seeing" was good. The entire routine of observations that I had planned and rehearsed carefully was accomplished without a hitch. Naturally I am much pleased.

"The corona flashed out in its radiance when the sun was blotted out. This halo around the sun was the type that is characteristic of the time of minimum sun-spots. The coronal rays extending from the sun's equator predominated and the short polar rays were sharply defined. There were two coronal streamers. If the sun is thought of as the face of a clock with 12 o'clock at its vertex, these streamers extended from positions corresponding to one and seven o'clock.

"Only from this little island, one of two situated in the path of total eclipse, were scientific observations made. The parties of Japanese astronomers here seem to have made successful observations.

"I have not yet had time to develop my photographic plates, but my two cameras of sixty-inch focus with quartz prisms were aimed at the inner and the outer corona. A polariscope measured the sky light close to the sun. The color distribution of the corona was studied by photographs taken through color filters. Spectrum photographs were also made of the sky light during eclipse and the sun's photosphere layer which lies close to its surface."

THE CONTROL OF WEEVILS IN RICE

COATING rice with mineral dusts, to keep down heat generation during milling, also discourages the breeding of insects that infest the stored grain, according to Dr. E. R. de Ong, consulting entomologist of San Francisco.

Weevil injury to stored stocks of rice becomes very severe at times since much of the crop must be carried through the hot weather of summer until the harvest in late fall. Insect breeding is rapid at summer temperatures and a light infestation in the spring, if unchecked, may result in almost complete destruction of the stock of rice by fall.

The difference in weevil infestation of rice coated with calcium carbonate and untreated rice was noticed and experiments made to determine the value of the coating for protection alone. In a jar of uncoated rice, several living rice weevils and bran bugs were placed. A similar number of living weevils and bran bugs were placed in another jar containing rice to which one per cent. of finely ground calcium carbonate had been added. These jars were kept at a temperature ranging from 50 to 75 degrees Fahrenheit, with sufficient moisture added to favor breeding.

In sixty days the rice weevils had decreased 50 per cent. in the coated rice and in the uncoated rice 25 per cent. The striking results, however, came at the end of a year following the higher summer temperatures which had stimulated breeding. The number of weevils in the coated rice had remained absolutely stationary throughout the year. That is, there had been just sufficient breeding to equal the small number dying. In the uncoated rice the weevils had increased more than one thousand per cent. The bran bugs had decreased slightly in both lots of rice, they apparently not finding conditions suitable for breeding.

The weevil attack in the uncoated rice resulted in a loss in weight of 42 per cent., a cubic foot of the coated rice weighing 76 pounds and the uncoated rice 44 pounds. The infested rice also had a very dirty appearance, necessitating the expense of recleaning besides the additional loss of weight.

EARTH LEVEL AND THE INDIAN EARTHQUAKE

DR. J. DE GRAAF HUNTER, formerly director of the Survey of India, explained at a geophysical discussion held at the headquarters of the Royal Astronomical Society in London that the level of the part of India where the disastrous earthquake of January 15 occurred has been rising at an average rate of .06 foot a year, or six feet a century, for the last seventy years at least. The earthquake was associated with this change of level, together with the unique state of internal stress which has hitherto occurred in this region.

Two years ago, when Dr. de Graaf Hunter was endeavoring to reconcile the numerous spirit-level observations made in Bengal between the years 1862 and 1930, he found evidence that the land was rising at a regular rate. He constructed a diagram in which lines drawn on a map of northern India indicated the various rates at which the rise of level was taking place.

The lines passing through places having the same rate of change ran approximately west-southwest to east-northeast. The line indicating zero change of level passed about fifty miles north of Calcutta. The line indicating the maximum change of .06 foot a year ran about thirty miles north of Benares, and passed through the position calculated to be the epicenter of the January 15 earthquake. This position is latitude 26 degrees minutes, longitude 86 degrees 3 minutes.

ITEMS

THE scientific findings of the explorers of the stratosphere in the Soviet "stratostat" USSR are at variance with the theoretical calculations of physicists, it appears from an announcement by Professor A. Wangenheim. Analysis of samples of air taken during the flight last September showed that the oxygen content of the stratosphere 19 kilometers (11.8 miles) above the surface of the earth varies very little from the oxygen content of the air at the surface. The analyses were carried out by a special commission under the leadership of Academician A. A. Chernishev, of the Institute of Physical Chemistry, Moscow. Tests of the samples of air, made in two laboratories, proved identical in their results, which contradict the theoretical calculations of investigators such as Wegener, Shtermer, Humphrey and Gutenberg, which indicated an oxygen content of not more than 15 to 18 per cent. At sea-level the atmosphere contains 21 per cent. oxygen and 78 per cent. nitrogen.

SPECIAL underwater spectacles that allow lifeguards and divers to see clearly beneath the water's surface have been devised by Robert E. Cornish, of the Institute of Experimental Biology of the University of California. The normal human eye, developed for vision in air, is a very poor instrument under water, as every swimmer knows. The reason is that the contact of water with the cornea robs the eye of about two thirds of its refracting power. This trouble is avoided in divers' outfits by keeping water away from the eye and looking through a flat window of glass. If the glass is wet by condensation or splashing it loses its advantages.

JUICE from the turnip is recommended as a good depression substitute for orange juice or tomato juice. Attention is called to its value as a cheap source of scurvy-preventing vitamin C by Dr. E. W. McHenry, of the University of Toronto School of Hygiene, in a report to the *Journal* of the Canadian Medical Association. In Toronto one cent will buy 1,100 vitamin C units from turnip juice, whereas the number of vitamin C units from one cent's worth of lemon juice are 180, from orange juice 220, from tomato purchased as juice 170 and from tomato juice prepared from canned tomatoes 180.

CIGARETTE beetles, tiny but destructive enemies of warehoused tobacco, are successfully fought with a new weapon developed by W. D. Reed, entomologist of the U. S. Department of Agriculture. The trap uses a moderately bright electric light to lure the insects, an electric fan to suck them in, and a glass jar to hold them captive when caught. An ordinary pint jar will hold 150,000 of the beetles; a larger jar can be substituted when the catch is likely to be greater. The whole trap is suspended from the ceiling, out of the way of the warehouse workers.

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SCIENCE NEWS

Science Service, Washington, D. C.

A LATENT IMAGE MECHANISM

A NON-LIVING "electrical eye" apparatus that has persistence of vision similar to that of the human eye was described by Dr. V. K. Zworykin, the RCA Victor Co. television inventor, at the meetings of the American Physical Society. It promises aid to astronomy, biology and other sciences as well as television.

It is an electrical latent image mechanism that stores electrically the information from an optical image projected on a mosaic of tiny cells that convert light into electricity. It can reproduce its electrically stored information when it is desired. Persistence of vision in human seeing is important in viewing movies, for instance. It results from the ability of the eye's retina to continue to register for a fraction of a second after light has ceased to fall upon it. Dr. Zworykin has made an apparatus that improves upon the eye in several respects.

The original Zworykin device was developed as a pickup camera for television. It is a part of the very promising television method that has encouraged scientists and engineers to believe that practical development of television may be "just around the corner" if people are willing to pay for it. The new form of electric eye is sensitive to ultra-violet rays and infra-red rays or heat that are invisible to the human eye. It can allow the amplification of light intensity of the image so as to increase its intensity many times. An electrical magnification of the scene being viewed is easily accomplished.

Dr. Zworykin explained that the broad idea behind his electrical latent image apparatus is not new, but that he has developed several different methods of applying the idea. A simple electrical experiment illustrates the principle behind the Zworykin apparatus. A condenser is connected in series with a photocell. The photocell is illuminated. The light on the photocell is converted into electricity which flows and charges the condenser. The condenser is made to discharge by flashing upon it a beam of electrons shot from a cathode tube.

The simplest form of the Zworykin latent image apparatus consists of a screen placed in a vacuum bulb. The screen is a thin sheet of mica coated on the back side with a continuous metal layer. On its front there is a mosaic of small isolated photo-sensitive globules, each a miniature mechanism for changing light into electricity.

Dr. Zworykin makes this mosaic very simply by evaporating a thin film of silver upon the mica, then breaking it into separate particles by heat and sensitizing the silver with the element caesium. The globules "soak up" the light converted into electricity when an image is projected by lenses upon the screen. Each photo-sensitive globule gets a positive electrical charge in proportion to the amount of light that falls upon it.

The screen is scanned regularly by the electron beam that releases these charges and this produces changes in the electrical capacity of the metal layer on the other side of the mica. By attaching an amplifying system to that metal layer, there can be drawn off from the system a fluctuating current that is an electrical representation of the light picture on the screen.

SOLAR RADIATION

ENERGY, on a scale so vast as to baffle all human imagination, poured into space by the sun, was one of the subjects discussed in the third Arthur Lecture, presented in Washington by Dr. Charles Greeley Abbot, secretary of the Smithsonian Institution.

Calculations on the known mass of the sun and its estimated mean temperature indicate that every year it radiates into space the heat equivalent of 400 billions of trillions of tons of anthracite coal. Of this prodigious amount the earth intercepts the equivalent of 200 trillions of tons. Compared merely with the small part of solar radiation intercepted by the earth, the total yearly consumption of coal for heat, light and power in the United States is trifling—only 500 million tons.

"This leads," continued Dr. Abbot, "to the inquiry why we depend on coal, oil and waterfalls for power, when the sun is furnishing to the earth so incomparably much more energy free, gratis, for nothing. There are two reasons. In the first place, clouds and night interrupt the continuity of the supply, and cut it off just at those times when we need power badly. Even during the day, the rays alter very much in their intensity because they shine through great thicknesses of the atmosphere in the early morning and the late afternoon. Night also varies greatly in length between summer and winter in temperate zones where the most power is used. Unfortunately, night is longest in winter when we need most power.

"Secondly, though sun rays cost nothing to produce, they cost much to capture. If their energy could be fully utilized it would require only about a square yard for one horepower. But the losses unavoidable in using sun rays for power will demand provision of at least four and probably ten square yards per horsepower. In fact no solar power plants thus far have reached such efficiency. To install apparatus over 10,000 square yards to obtain 1,000 horsepower, or over 10,000,000 square yards to match Niagara, may well give engineers pause."

Yet in spite of the difficulty of gathering up this scattered gold of sun-power, the task is not quite hopeless. Dr. Abbot described two experimental plants that have been built to operate on solar heat applied to boilers and made to run engines. Although their construction cost, per horse power, was several times that of a steam plant, yet in desert countries where fuel is scarce and sunlight plentiful they could offer a fair degree of competition to the more conventional power apparatus.

Dr. Abbot also described a sun-heat cooker which he himself built on Mount Wilson, California, which captures and concentrates heat enough to bake bread, preserve fruit, and do other kitchen jobs very successfully.

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FLYING IN THE FOG

HOPES that flying in foggy weather could be made safer by the use of infra-red radiation were blasted by scientists and engineers gathered in Washington at the request of the Bureau of Aeronautics of the U. S. Department of Commerce for a conference on the problem of overcoming the hazard of fog.

There is no known source for obtaining infra-red radiation of the wave-lengths necessary for penetrating fog in energies of more than a few millionths of a millionth of a volt, it was pointed out by Dr. Irving Langmuir, of the General Electric Research Laboratory, and others in the discussion. No one knows how to produce this type of radiation in useful amounts. The discovery of a way to produce such radiation would be a stroke of genius and is not likely to occur in the course of routine experimentation.

The scientists also discouraged governmental experimentation with proposed schemes for dissipation of fog by use of the Tesla coil and other means. Such plans have been tested for many years, but Dr. W. J. Humphreys stated that it is well known to physicists that it is theoretically impossible for them to work well enough to be of practical use. Those that are based on sound scientific principles are too expensive to be considered for use in aviation.

Two possible solutions to the problem of fog landings were, however, given sanction by the meeting, and intensive research along these lines was urged. The first aid to the fog-bound fliers will be the radio. It is known positively that radio will penetrate fog. And radio signals can indicate to the flier, by the use of instruments, his location with reference to the flying field. It is true that they do not give distances shorter than the length of the radio wave-length used, but it is now possible to use wave-lengths as short as 10 meters (10.9 yards) for this purpose. These are very good; it is not necessary to wait until one centimeter or ten centimeter wave-lengths are available.

Another aid which further research may adapt for the use of the flier is the device used by vessels to determine the depth of the water beneath the hull by measuring the time required for a sound to return as an echo. A similar device has already been tried on airplanes, but at present it is necessary for the flier to judge from the loudness of the sound how far he is above the earth. It would be quite possible to have an instrument pick up the echo and show on a dial the height of the plane in feet above the landing field.

HEAT DESTRUCTION OF LAYERS OF THE CORTEX

A NEW tool for physiologists and brain surgeons, the precision of which will surpass the keenest of scalpels and steadiest of hands, was described by Dr. J. G. Dusser de Barenne, Sterling Professor of Physiology at the Yale School of Medicine. Speaking before the Association of Yale Alumni in Medicine, Dr. Dusser de Barenne explained the technique, devised by him, whereby any number of the consecutive layers of nerve cells in the cerebral cortex, the thin outer coat of gray matter of the brain, may be destroyed at will.

This method solves one of the difficulties long encountered in studies to determine the functions of the different areas of the cortex controlling bodily activities. Hitherto investigators have not been able to distinguish between the functions of the different layers because there has been no way of eliminating one or more layers selectively. The cerebral cortex consists of only six layers of nerve cells, except in the motor area where there are five.

"Laminar thermocoagulation of the cortex," brought about by the local application of moderate heat for a short period of time to the exposed surface of the brain, is the new technique announced by Dr. Dusser de Barenne. The depth to which the tissue is killed depends upon the temperature and the length of time heat is applied.

It was found that heating to between 90 and 100 degrees Centigrade for five seconds results in death of all the nerve cells in the heated area throughout the whole thickness of the cortex. By heating to about 70 degrees Centigrade from one to two seconds, it is possible to kill the nerve cells of only two superficial layers.

As an example of results which can be obtained by the new method in determining the functions of the different layers of the cortex, Dr. Dusser de Barenne said that he had found that the movements obtainable on electrical stimulation of the motor cortex are due to direct stimulation of the two inner layers and in all probability to the direct stimulation of the large nerve cells of the fourth layer.

Microscopic studies reveal that this method of destroying a predetermined number of layers of nerve cells over a large or small area does not damage the immediately adjoining cortex, and that the dead tissue is resorbed within a few months without leaving any scar or distortion. This new method of nerve cell destruction is expected to prove useful in human brain surgery in special cases, such as cortical focal epilepsy, in which a sharply localized extirpation of part of the cortex is necessary.

THE MENTAL AND PHYSICAL GROWTH OF CHILDREN

DR. T. WINGATE TODD, Western Reserve University, speaking before a Conference on Child Development, Care and Training, in Washington, stated that the child's record of achievement should be distinguished from his progress in maturity or growth. The former does not always keep pace with the latter.

"Physical growth of the body covers some twenty years in human life, but physical growth of the brain is practically completed in six years, and in the better-nurtured children in four." The speed with which the child's achievements follow after his development makes them possible, depends upon his opportunities for education. "Capacity for walking is attained at twelve months or soon afterward, but capacity for riding a tricycle is not attained until about three years. The achievement of these accomplishments is, however, not necessarily completed at these ages.

"By comparison with anthropoid growth, a child's

life has four significant subdivisions, namely: infancy (birth to two years), the preschool period (two to six years), the grade school period (six to twelve years) and adolescence (twelve to eighteen years). In human life, infancy and the grade school period are greatly prolonged for in the anthropoid these occupy about one year and two years, respectively.

"Until the school plateau in physical maturity is reached, the better nurtured children are physically the larger and mentally the more advanced. After the attainment of six years bodily growth continues but the so-called mental growth is really a mental expansion depending upon the integration of experience in a brain which already has the functional capacity of adult structure." The problems of adolescence are a result of the rapid spurt of maturity at that time. "The attainment of adolescence is a feature of maturity progress rather than a stage in physical growth. It is expressed in certain physical features which are intimately related to the mental outlook but social perspective and emotional balance depend upon the educational processes of experience. This is the clue to the differentiating personality. In a a phase of rapid progress in maturity, such as occurs towards the second birthday or at puberty, change in outlook outruns the accumulation of experience and temporary disharmonies result in problems of social perspective and emotional balance. It is, therefore, during these periods when adjustment taxes the child's developing personality that understanding, patience and skill on the part of the guardians are of greatest significance in the developing citizenship-value of the child."

ITEMS

THE recording cosmic-ray meter taken to an altitude of 61,243 feet on the Settle-Fordney stratosphere flight brought back a message that Professor A. H. Compton and Dr. R. J. Stephenson, of the University of Chicago, interpret as meaning that cosmic rays are charged particles, not radiation like super gamma rays or x-rays. To the American Physical Society, meeting on February 24, Dr. Compton announced this interpretation. The relationship between the ionization shown by the meter and the altitude is such that Professor Compton does not believe that it can be explained by radiations of the gamma ray type, but it does fit in with the effects produced by alpha rays or ionizing particles with a definite range.

REPORTS from Italy that automobiles have been operated on a gas fuel made in transit from charcoal and steam recall experiments along the same line that were made several years ago in France and other European countries. The principle is that involved in the manufacture of some kinds of gas used in cities and in operating stationary internal combustion engines. Some carbon-containing material, usually coal, is heated and then water in the form of steam is run over it. Carbon monoxide and hydrogen are formed. Both are gases that will burn with high heat output. Mixtures of this sort are called "water gas" or "producer gas." Such gas can be used as fuel in internal combustion engines in vaporized gasoline. Usually these gas engines are not used on trucks or autos because of the difficulty of carrying around the fuel supply. They are effectively used for power generation in permanent locations. Trucks that run on wood, charcoal, manufacturing their own gaseous fuel as they go along, are used commercially in France to a limited extent.

DR. R. W. SKINNER, assistant chief of chemical and technological research, recently reported to congressmen comprising the subcommittee of the House committee on appropriations for the Department of Agriculture, that alcohol blended with gasoline is not completely satisfactory when used as a motor fuel. There are both technical difficulties and operating difficulties. The mileage obtained from a gallon of such fuel is less than that obtained from straight gas. Depending upon the proportion of alcohol used, there may or may not be a decrease in power. There are technical difficulties in the way of preparing alcohol from corn which can be used in such a mixture.

YELLOWSTONE NATIONAL PARK has a new pool, situated in Midway Geyser Basin. Ranger Frank Child passed through the region late in January, and saw nothing unusual. But when he returned during the following week, the pool was there, about forty feet in diameter. In being born it caused the dislocation of several tons of rock. Some of the dislodged rocks, now thirty feet distant from the pool, are estimated to weigh more than 600 pounds. The new pool is very hot and very muddy. Violent boiling occasionally takes place on the north side. When this occurs a slight shock can be felt several feet from the edge.

LEE STRONG, chief of the Bureau of Entomology, has warned members of the House subcommittee on appropriations for the Department of Agriculture, that grasshopper trouble can be expected in six Northwestern states this year. Surveys of eggs in the soil have shown federal workers what to expect in Montana, Nebraska, Wyoming and the Dakotas, and possibly to a lesser extent in Minnesota, where the state has carried on for two years an effective control program. Grasshopper damage in Montana in 1933 is estimated at almost $3,000,000 and in North Dakota at $10,250,000 in wheat, oats, barley, corn and flax. South Dakota estimates its damage at $3,600,000 and Wyoming at $250,000.

A NEW way of tracing the origin and early activities of Polynesian peoples is to be tried by Yale scientists. The new attack on the problem will be an investigation of over 2,500 wood specimens from remote islands of the South Seas. By studying these samples of wood, and comparing them with old wooden implements used by Polynesians, the Yale School of Forestry hopes to learn more about where the islanders came from, and with what regions they had contact. The collection of South Sea woods has been given to the School of Forestry by the Bernice P. Bishop Museum of Honolulu, and is intended for use in the systematic study of woods of the entire world now being sponsored by Yale in cooperation with the International Association of Wood Anatomists.

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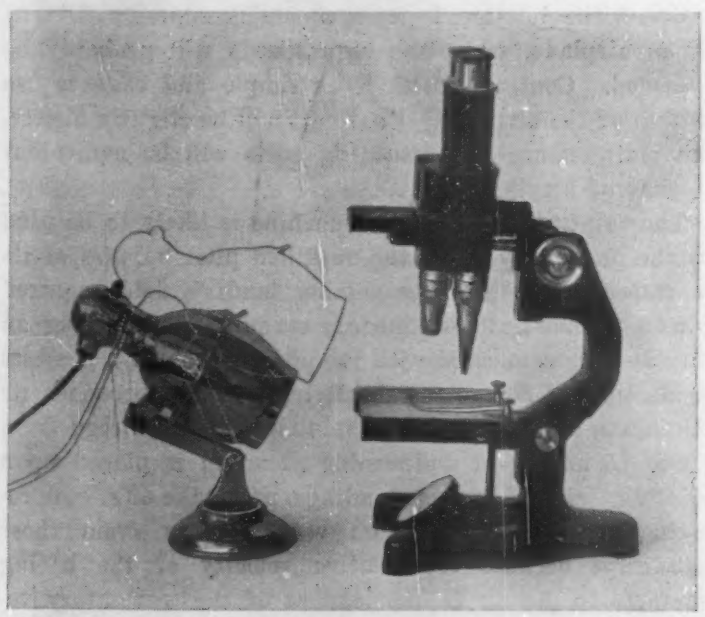

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SCIENCE NEWS

Science Service, Washington, D. C.

THE TREND IN FLYING MACHINES

FLYING machines with rotating wings will be superior to the conventional airplane as soon as their possibilities for high speed are practically developed, according to a prediction made by John B. Wheatley, aeronautical engineer of the National Advisory Committee for Aeronautics, at the annual meeting of the Society of Automotive Engineers.

The autogiro and the gyroplane are the two types of rotating-wing aircraft which, according to Mr. Wheatley's analysis, have the possibilities of becoming superior to the conventional type of fixed wing airplane now widely used. The reason for the pronounced possibility of the autogiro and the gyroplane is the inherent ability of their rotors or moving wings to attain their maximum lift-drag ratio at any desired forward speed.

The novel cyclogiro, with the paddle-wheel wings, is rated by Mr. Wheatley as being approximately equal in merit to the airplane, while the heliocopter is definitely inferior.

The autogiro is the best known of all rotating-wing aircraft. It was invented by Juan de la Cierva, and the American version of the autogiro, which has been flown extensively in this country, has been produced by Harold F. Pitcairn, working with the Spanish inventor.

The gyroplane is sponsored by E. Burke Wilford, of Philadelphia. The autogiro and the gyroplane present a very similar appearance with blades that rotate freely under the action of air forces about a vertical axis, replacing to a large extent the conventional wing of the airplane. Mr. Wheatley explains that the aerodynamical principles of the autogiro and gyroplane are practically identical and that their differences are largely structural.

"The low-speed control is superior to that of the airplane," Mr. Wheatley said in reference to the autogiro and the gyroplane. "The reliabilitty is equivalent to that of an airplane, and emergency landings will be easier. The low-speed performance is superior to that of an airplane. Airplane high speeds will probably be exceeded. Control system is as simple and easy to use as that of the airplane. First cost will be slightly higher, but maintenance and operating costs will be equivalent to that of airplane."

The rotating-wing type of machine is likely to be used by the private flyer and the unskilled pilot because of its increased safety and the smaller landing field required for it. Almost all the hazards encountered in flying an airplane are connected with the phenomenon of a gradual weakening of control as the flying speed approaches its minimum, he explained. As minimum speeds range from 50 to 75 m.p.h. an undesirable premium is placed upon piloting technic during landings and take-offs. A rotating-wing aircraft suffers very slightly from these handicaps because the relative velocity of the lifting surfaces to the air is independent of the translatory velocity of the machine and is always large, so that the angle of attack of the lifting surfaces is well below the burble point. The resultant performance of rotating-wing aircraft thus materially extends downward the low-speed phase of flight, lessening the piloting skill required for emergency landings and take-offs, and making the pilot more independent of meteorological conditions because at low speed a shorter visibility is required for the same degree of safety.

Intensive wind tunnel research on the gyroplane is being conducted by the National Advisory Committee for Aeronautics at its Langley Field laboratories. The possibilities of the gyroplane aerodynamic system have already been investigated and now a 10-foot diameter model of the rotor is the subject of experiments. The autogiro has already been given considerable attention by the National Advisory Committee for Aeronautics.

The cyclogiro, which Mr. Wheatley rates as being approximately equal in merit to the airplane, is of such recent origin that it has not yet been demonstrated at full scale. It consists of a fuselage of conventional form, supported in the air by power-driven paddle-wheel wings, one on each side, rotating about the lateral axis. The paddle-wheel rotors perform the functions of both the wings and the propeller of the conventional airplane.

ALUMINUM-COATED TELESCOPE MIRRORS

THE great 200-inch telescope now being planned at Pasadena will be coated with an aluminum layer of high reflecting power instead of the silver that has been the standard material for many decades. The process for making such high quality mirror surfaces has been sought a long time, but satisfactory results have been obtained only recently through the experiments of Dr. J. Strong, of the California Institute of Technology.

It is important to get the surface to be vapor plated really clean. What is clean enough for silver plating is by no means satisfactory for aluminum. Dr. Strong blasts off the final contamination by a bombardment with electrons and ions.

The next puzzle was to find a suitable way of getting the aluminum to go where it was required. This is done by melting the aluminum on a tungsten wire of just the right size and shape. If the wire is too fine the molten aluminum will dissolve it and burn out. The wire in the form of a helix is heated until the aluminum evaporates and deposits on cooler surfaces near-by. This requires that the process take place in a high vacuum.

Dr. Strong has coated many small mirrors for instruments at the Mount Wilson Observatory with great success. Aluminum has an enormous advantage in reflecting ultra-violet light. Silver and everything else so far used are very poor as reflectors in comparison. Because of silver's shortcomings, the reflecting type telescope was inefficient. Aluminum will reflect well all the light that gets through the atmosphere.

The aluminum coating can be "laundered." The aluminum surface develops an invisible coat of aluminum oxide which protects the metal without tarnishing like

silver. It can be washed over and over with soap and water. It is thus not only much better but much more durable than silver which is now commonly used.

The biggest mirror so far coated is the 36-inch reflector of the Lick Observatory. The coating was applied by Dr. Strong. It required a vacuum chamber big enough for several people to sit in. The chamber for the 200-inch diameter mirror (almost 17 feet across) will be gigantic by comparison but only technical difficulties are involved in its construction.

THE FERTILIZATION OF RABBIT EGGS IN VITRO

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RABBITS, developed from eggs that were fertilized outside the mother's body and brought to birth in the body of a second mother rabbit, have been produced in the Harvard University laboratory of general physiology by Professor Gregory Pincus and E. V. Enzmann.

Each of the two litters of "ectofertilized" rabbits which Professor Pincus and Mr. Enzmann have succeeded in obtaining may in a sense be said to have had three fathers and two mothers, for in each case three male and two female rabbits were required for the process. In the strict biological sense, of course, the real mothers were the females that supplied the ova and the real fathers were the males that supplied the sperm; the others would rate more as auxiliary or foster parents.

To produce their "ectofertilized" rabbits, a female rabbit was mated with a male which had been rendered incapable of producing sex cells by a simple surgical operation. The mating act stimulated the first steps in the development of the ova, or female sex cells, which, however, still remained unfertilized.

Then the ova were removed from the mother rabbit's body and placed in a suitable fluid in a glass vessel. Sperm from a normal male rabbit was added, and allowed to remain with the ova until each one had received the fertilizing male cell. Certain changes observable under the microscope indicated to the watchers that this process had taken place.

In the meantime, the "foster-mother" rabbit had been prepared for her rôle by being mated with another male incapable of producing functional sex cells. Into her maternal tissues, thus stimulated to activity, the ova of the other rabbit, fertilized in a glass vessel with the sperm of a male she had never seen, were introduced. They developed, and in due time the young rabbits were brought forth.

In order to have a check on the correctness of their technique and to make sure that the second mother rabbit's own ova were not chance-fertilized by stray sperm-cells, rabbits of different breeds were used throughout, so that the coat color of the young ones would indicate their actual parentage. This was in both cases indubitably traceable to the ova and sperm cells in the glass vessel.

In reporting their work to the National Academy of Sciences, Professor Pincus and Mr. Enzmann comment, "We believe, therefore, that this is the first certain demonstration that mammalian eggs can be fertilized in vitro."

THE FORMATION OF BUTTRESSES ON CYPRESS TREES

CYPRESS buttresses, those curious wide outgrowths that develop around the bases of these water-dwelling trees, are formed only when air and water have a chance to act together on the wood-forming tissues. Cypress trees growing on permanently dry land, or with their roots permanently covered with deep water, are alike in not forming buttresses.

So state Professor Herman Kurz, of Florida State College, and Dr. Delzie Demaree, of Stanford University, in the current issue of *Ecology*. Professor Kurz has had unusual opportunity for observing cypresses in the vast swamp-forests of northern Florida, and Dr. Demaree has made a special study of the trees of the Reelfoot Lake region in northwestern Tennessee, where great areas of already existing forest were partly submerged by the great New Madrid earthquake of over a century ago.

Everywhere the story is the same. Where there is no standing water the cypresses form no buttresses. Where the water level is shallow and constant, the buttresses are low but very wide. Where the water level fluctuates considerably, buttresses of a more or less conical shape develop. An interesting variant of this latter condition was discovered by Professor Kurz in some moderately deep cypress lakes that went suddenly dry and then refilled, a season or two ago. Here the tree-trunks had buttresses twelve feet or more high, with "waists" in them, so that they resemble the bottles in which a familiar soft drink is sold.

The form and magnitude of the buttresses are directly proportional to the total time that the various buttress horizons are in contact with air and water. This relation is so clearly revealed by the buttress forms that their profiles may be used to interpret water depth and water level fluctuations of lakes in which cypresses grow.

Dr. Demaree found convincing evidence that buttresses are not necessarily formed around roots, when the water level of Reelfoot Lake sank far below normal during recently droughty summers. The trees growing in this lake, which date back to before the great earthquake subsidence, have formed typical buttresses far up their trunks, which were left hanging high and dry by the lowering of the lake level. He terms this type "bell buttresses."

Cypress "knees," conical spongy-wooded upgrowths on the trees' roots, are formed as the buttresses are formed, only where air and water work together, the two botanists state. Botanists hitherto have considered knees as organs of aeration. Professor Kurz and Dr. Demaree, on the contrary, consider these outgrowths as responses to air and water. They never appear on the roots of dry-land cypresses, and never on cypress roots immersed permanently in deep water.

SCIENCE AND HUMAN WELFARE

SCIENCE, under controversy in many quarters as a prime contributor to the present disturbed condition of

the world, was pointed out as a possible and even necessary contributor to world recovery and further progress, by Dr. John C. Merriam, who spoke recently before the American Philosophical Society. Like the long-discussed conflict of science and religion, according to Dr. Merriam, the assumed clash between natural science and social science is possible only when there is interference with normal exchange of ideas.

Much of Dr. Merriam's address was concerned with the problems of conservation, and the ways in which science can come to the aid of economic reconstruction and sound long-time planning for future generations. Natural resources of the irreplaceable type, like oil and minerals, hitherto recklessly and wastefullly exploited as they have been discovered, largely by chance, can be much more wisely administered if the extent and availability of their deposits are mapped out by scientific surveys, and if science is further invoked in working out methods for their most efficient use. Resources that renew themselves in humanly measurable time, like timber and game animals, are even more susceptible to proper scientific management.

But conservation can serve more than man's bread-needs alone. Dr. Merriam pointed out the possible services of science in the preservation or restoration of natural areas fitted for esthetic enjoyment, educational development, and even religious contemplation. The national parks of America and the great temple groves of China were indicated as already existing examples.

Finally, the speaker suggested that science must contribute its share toward answering the difficult question of what things, both in the material world and in the domain of social relations, must be adhered to as that which is good and therefore to be defended against tendencies of change, and what things are legitimately subject to further evolution, whether through the ordinary processes of nature or through the hastening aid of man.

ITEMS

ARTIFICIAL radioactivity has been produced at Cavendish Laboratory in Cambridge by bombarding graphite with high velocity protons. This man-made radioactivity confirms and extends the work of F. Joliot and Irene Curie-Joliot in Paris who a few weeks ago discovered artificial radioactivity. Drs. J. D. Cockcroft, C. W. Gilbert and E. T. S. Walton speeded the hydrogen nuclei or protons to a high velocity with the same 600,000-volt tube that has previously performed important atomic transmutations. Positrons or positive electrons were produced. The new radio element produced lost half its activity in ten minutes. It is believed that the radioactive element formed in nitrogen of mass 13 is created by the addition of a proton to the ordinary carbon mass 12 of the graphite. A report is being published in *Nature*.

PREDICTION of earthquakes a few hours before they occur may be possible in the future as a result of studies that have been made in Japan, according to Captain N. H. Heck, chief of the Division of Terrestrial Magnetism and Seismology of the U. S. Coast and Geodetic Survey, in an address before the Brooklyn Academy of Arts and Sciences. In a number of earthquakes there was perceptible tilt of the ground several hours before the earthquake, Captain Heck said. In one case the villagers observing the tilt, feared a tidal wave and took to the hills. The tidal wave and earthquake came later. A new machine for measuring tilt of the ground has been invented by George E. Merritt, formerly of the U. S. Bureau of Standards, and installed in California through the cooperation of the U. S. Coast and Geodetic Survey and the University of California. This apparatus is expected to throw new light on earthquake problems in California. Tilt on a large scale and the creep of the earth's crust, known to be a factor in earthquake production, can be detected through triangulation and leveling, such as being undertaken by the Coast and Geodetic Survey. Prediction of earthquakes, however, lies in the future, according to Captain Heck. We now have, he said, no possibility of prediction beyond indicating whether or not a certain region is likely to have an earthquake in the not too distant future.

FOUR or five thousand years before the Children of Israel came seeking their Promised Land, Palestine had a dry climate and was mainly desert. Earlier, in the Aurignacian period of the Old Stone Age, the Palestine landscape was wooded, though gradually developing open spaces. Still earlier, in the latter part of the Mousterian period—the age of the uncouth, clumsy Neanderthal men—the land of Palestine was heavily wooded, due to heavy rainfall. In the first part of the Mousterian, Palestine was a warm and pleasant land with large rivers and hills clad with forest. These suggestions are made by Miss Dorothy Garrod, British anthropologist, and Theodore McCown, of Berkeley, California, as a result of their examinations of deposits they excavated as members of the joint expedition to the neighborhood of Mount Carmel from the American School of Prehistoric Studies and the British School of Archeology in Jerusalem. In the deposits of the Mousterian period they found fossils of rhinoceros, hippopotamus, crocodile and wart-hog, indicating that the climate was subtropical or tropical. Fossils of other species, such as deer, suggested the topography.

EFFORTS are being made in Germany to build up a supplementary herd of wisent, or European bison, almost exterminated as a result of the war, by an interesting technique called "Verdrängungszucht," or "suppression breeding." Surplus wisent bulls have been bred to American bison cows. Only female calves are kept, and these are bred back to wisent sires, each generation thus getting rid of half the remaining bison blood, until finally a stock of practically pure wisent will remain. This experiment is being carried on at the reserve at Springe, but it is expected that the herd will soon be transferred to roomier pastures in Brandenburg.

THANKS to systematic protection of wild life, Sweden has now at least 40,000 moose, whereas a decade ago there was grave danger of their extinction. Last year 6,335 were shot during the four days' open season, as compared with 5,740 the year before and only 381 ten years ago. Poachers get about 600, Government Forester Torsten Wennmark estimates.

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SCIENCE NEWS

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THE ENERGY OF POSITRONS

THE manufacture of matter out of energy, theoretically possible according to Einstein's theory of relativity, is demonstrated by experiments in which positrons, the new building blocks of matter, are produced.

To the Royal Society, Drs. J. Chadwick, P. M. S. Blackett and G. Occhialini, of Cavendish Laboratory, Cambridge, recently reported that their observations of the energy of positrons produced in gamma ray bombardment confirm the idea that the interaction of a gamma ray with an atom always produces an electron simultaneously with a positron and that both of these particles have the same mass.

While the artificial radioactivity discovered by the Joliots in Paris a few weeks ago may show that the positrons ejected from disintegrating atomic hearts are contained in these atoms themselves, the experiments at Cambridge by three bombardment methods seem to confirm the hypothesis that the twin electrons are created from radiant energy in the field of influence of the atom outside its nucleus.

If atomic nuclei permanently contain positrons, according to Dr. Blackett, the positrons must be "inoculated" in some manner against annihilation. Perhaps this is accomplished by a closer union with some other particle. Normally the positron, almost immediately that it is created, combines with an electron to form radiation.

Dr. G. Temple, professor of mathematics at the University of London, presented the first quantum theory of the neutron, which was developed by squaring the Dirac equation, which was so useful in predicting the positron before it was discovered. He followed the method of Sir Arthur Eddington, although there is an admitted theoretical drawback, since the Dirac analysis was directed to a linear equation. But Professor Temple added no arbitrary constants.

One set of solutions of the new equation yielded results referring to the ordinary hydrogen atom and another set referred to the neutron. The equation gave the effective radius and binding energy of the neutron which agrees well with the estimates made by Dr. Chadwick.

The quantum theory at present fails to explain why all hydrogen atoms do not collapse into neutrons. This is partially explained by Professor Temple's wave equations which indicate that hydrogen is in such a state as to permit no transitions.

THE SPEED OF LIGHTNING

How fast does a thunderbolt travel? This question has been answered by Dr. B. F. J. Shonland, of the Cape Town University, and H. Collens, of the Victoria Falls and Transvaal Power Company.

Using a camera provided with two lenses revolving in a circle at opposite ends of a diameter, an arrangement described by C. V. Boys in 1926, the two experimenters photographed a number of lightning strokes between earth and cloud. A moving lens tilts the image of a lightning flash on the plate much as a focal plane shutter causes a swiftly moving automobile to seem to lean forward. The other lens, moving in the opposite direction, tilts the image the other way, so that the real angle of tilt is found as half the angle between the two images. Knowing the speed of the lenses, which made 1,500 revolutions per minute, the experimenters could find not only the duration of the discharge, but which way it was going and how fast. They could determine also how long the luminosity persisted after the discharge had ceased, and other details.

Almost always, they found, the main flash was preceded by a faint "leader" as they call it. This traveled downward from the negatively charged cloud to the positively charged earth. As soon as it struck the earth, the main flash started upward from the same spot, and followed exactly the same path that the leader had taken, to the cloud.

The leaders were invariably thin, of uniform width, and unbranched. Their speeds ranged from 810 to 19,000 miles per second. They averaged 5,150 miles. The length of the strokes observed varied from 1.6 to 4.7 miles. The longest time occupied by a leader stroke was 1,670 micro-(millionths) seconds for a 4.7-mile stroke. The quickest flash took 69 micro-seconds to travel 3.5 miles.

The lengths of the strokes were measured along the crinkly paths registered on the plates. These did not show of course the motion toward or away from the camera, and the experimenters estimated that the real lengths of the strokes in space, and consequently the real velocities, were about 30 per cent. higher than those measured.

The leader appeared to be composed of an elongated dart. From the width of the track on the plate, the investigators were able to determine the duration of the luminosity at any point, and assuming that this was the time required for the dart to pass the point, they were able to measure the lengths of the darts. These varied from 80 to 370 feet, the average being 180 feet.

In conformity with the theory proposed by Dr. N. Ernest Dorsey in 1926, the authors believe that the leader consists of an "electron avalanch," which goes ahead and ionizes the air, thus preparing a conducting path for the main discharge that follows.

The main discharge is entirely different in character. It is thicker and brighter, and the thickness diminishes upward. It is more like a soaring flame than a moving dart. Also it travels faster. The speeds ranged from 14,900 to 68,400 miles per second, the average being 28,500 or about 15 per cent. of the speed of light.

Often the main upward discharges were branched—but they branched downwards. After each branch the main stem thinned but did not pause in its upward motion. The branch occurs at or after the moment the head of the discharge passes the point. The branches did not always occur in regular sequence, a lower branch sometimes sprouting out after an upper branch had developed.

The time required for the discharge to reach the cloud varied from 44 to 65 micro-seconds. To reach the end of the last branch took from 40 to 145 micro-seconds. The bright luminosity at the base lasted from 12 to 164 micro-seconds. Usually it was out before the discharge reached the cloud, occasionally not. A faint luminosity, however, lasted much longer, sometimes as much as 1/50th of a second, as though the path had been heated and continued to glow.

THE TREATMENT OF BENZENE POISONING

THE many cases of sudden death due to benzene poisoning that occur each year in various industries where benzene is commonly used as a solvent may be prevented by an injection of the drug, acetyl-choline. This announcement was made before the New Haven Medical Society by Dr. Louis H. Nahum, of the Yale Medical School, who told of his work in this field with Dr. H. E. Hoff, also of the Yale medical faculty.

Benzol vapor, Dr. Nahum explained, produces an abnormal sensitivity of the heart to adrenalin, a common constituent of the blood, bringing about an irregularity in the heart-beat which causes death. Adrenalin, incidentally, is sometimes injected into a heart that has stopped beating in an effort to restore life. Excitement and physical activity predispose to the occurrence of sudden death by benzol vapor. Excitement, moreover, is a condition in which the adrenalin glands pour into the blood large amounts of adrenalin. Animals deprived of adrenalin did not die of ventricular-fibrillation, the fatal irregularity of heart action which appears to be the cause of death in benzene poisoning. It was found, further, that an injection of acetyl-choline counteracted the action of the adrenalin and protected the animals against this fatal irregularity.

This finding, while important in itself, opens up a new field of investigation of the causes for death by heart failure. Adrenalin under abnormal conditions, one of them being exposure to benzol vapors, produces ventricular-fibrillation. Whether other conditions, heretofore overlooked by physicians, predisposes the heart to the lethal action of the adrenalin, remains to be investigated.

A DEVICE FOR THE STUDY OF EARTHQUAKE EFFECTS

EARTHQUAKES will have less terror for cities in active seismic regions, as the result of engineering data obtainable with a new device demonstrated at the Massachusetts Institute of Technology. It is known as a stress recorder, and is the invention of A. C. Ruge, research associte in seismology in the department of civil engineering.

The stress recorder consists basically in a train of lenses and reflecting prisms, which pick up a slender beam of light and pass it on to a sheet of photographic paper mounted on a slowly rotating drum. So long as the system is at rest the pencil of light writes a straight line on the paper. But when a stress bends or displaces the support of one of the reflectors, the beam of light is correspondingly displaced, so that the line traced on the photographic paper becomes a curve, accurately recording the degree of bending and hence the force exerted at that point. A timing device, which splits time up into thousandths of a second, makes its record on the same sheet of paper.

The optical parts of the stress recorder total less than an ounce in weight, and models of the essential structural units of a steel building can be kept down to a few feet in height and a weight of a hundred pounds, so that the entire arrangement can easily be mounted on a "shaking table" which will simulate under laboratory conditions any type of earthquake whose effects on structure it is desired to study.

The stress recorder constitutes a simple mechanical short-cut to results previously obtainable only by the most tedious and long-drawn-out kind of labor with slide-rule and calculating machine; and some of the results obtainable with it represent the integration of forces so complex that their mathematical calculation by ordinary means is not possible at all.

THE DANGER OF CARBON MONOXIDE IN AUTOMOBILES

INSIDIOUS carbon monoxide gas seeping from engine into automobiles may be the cause of many unexplained accidents. In 1933, there were 58,900 unexplained automobile accidents in which cars driven off the roadway for no apparent reason killed 3,260 persons and injured 53,240.

During tests here conducted in cooperation with the Connecticut Motor Vehicle Department and Department of Health, air within typical "run of the road" automobiles, such as police cars, private passenger cars, busses and trucks, was examined for its carbon monoxide content.

The conclusion was that fully seven per cent. of motor vehicles when in operation contain enough carbon monoxide to cause the collapse of occupants. There was probability of serious accidents if drivers were exposed to these dangerous atmospheres four or more hours. At least sixty per cent. of automobiles tested contained measurable quantities of the gas when in operation.

The first symptoms of carbon monoxide poisoning include headache, dizziness, smarting eyes, drowsiness and nausea, which result in slowing down of mental processes. The report of the test thus holds that the gas which comes largely from poor combustion and escapes through leaking exhaust pipes may also be partly responsible for some of each year's several thousand accidents attributed to poor driving judgment.

The research, conducted by the Travelers' Insurance Company and the Cities Service Oil Company, found that it is possible for a dangerous concentration of carbon monoxide to accumulate within a car which is following another at the usual trailing distance. The gas may enter the trailing car whether its windows are open or shut.

SANDSTONE MARKINGS MADE BY SNAILS

SNAILS of the east coast of Africa have helped Professor Othenio Abel, of the University of Vienna, to solve the riddle of certain markings in fine-grained sandstones found near Vienna, that have stumped scientists for many years.

Some time ago, Professor Abel had opportunity to watch the behavior of the strand animals on the wet beaches of the east coast of Africa. A certain species of snail attracted his special attention. This snail, scientifically known as Bullia, is a veritable galloper among snails; it can travel over the wet sand at the rate of nearly a yard a minute. It feeds mostly on stranded jelly-fish; hundreds of the snails can be seen hastening to the feast wherever one of these luckless creatures has been washed ashore.

If the sand becomes too dry, or if something frightens the snail, it behaves in a most peculiar manner. It wraps its wide "foot" around its shell, turns a somersault, and disappears into the sand. There, having found a level at which the moisture is more to its liking, and concealment from any threatening foe as well, it goes on its subterranean way, mole-fashion. Naturally, this subterranean path leaves a burrow quite different from Bullia's surface tracks; and a comparison of the modern snail-burrows in the African beach sand and the puzzling markings in the ancient Austrian sandstone shows a most convincing similarity.

Clinching the argument even more closely was Professor Abel's observation that an abruptly ended surface track on a slab of the sandstone could be traced as a burrow-marking on the under-side of the same slab. The ancient Bullia had evidently seen something it did not like, dived, and "continued the march" underground, leaving its footprint in the gradually hardening sands of time.

ITEMS

DEFORMED pods, which add further to the destructive effects of the mosaic disease of peas, have become of considerable concern to the California grower of summer and fall peas, according to Dr. William C. Snyder, of the University of California. When the pea plant becomes infected with the virus prior to the completion of pod development, the pods become markedly distorted, the walls assume a rough, ridged, wrinkled condition and, as a result of the corrugations, is badly deformed and somewas dwarfed. Pods resulting from blossoms borne on a badly diseased vine may become so badly twisted or curled as to be hardly recognizable as pods. Such pods remain severely stunted and may produce no seed.

FRAGMENTS of clay that once went into the building of a New Stone Age hut, accidentally baked into a brick-like consistency by a chance fire, have preserved for thousands of years evidence that the neolithic farmers grew a species of wheat similar to that cultivated in the earliest fields of Egypt and Mesopotamia. Professor Fritz Netolitzky, of Rumania, identified the plant remains after soaking the clay fragments in water and patiently picking them to pieces. Professor Netolitzky tells of his discovery in a report to the *Forschungen und Fortschritte*. The investigation was carried on at the Wallraf-Richartz Museum, Cologne.

EASY living is hard on the parts of the pancreas that produce insulin; abstemiousness tends to repair the damage. This has been shown in the case of fish by Dr. Walter N. Hess, of Hamilton College, who used rainbow trout as his subjects. Some of them he overfed, others he put on a diet too high in fat-forming foods, and still others he fed normally but kept under-exercised. In all cases, the islets of Langerhans in the pancreas, which are the insulin-producing areas, diminished in number and degenerated in condition. However, when Dr. Hess put similarly pampered trout on a diet low in fat-producing materials and kept them thus in training for a time, the damaged vital portions of the pancreas showed a high degree of regeneration.

STONY meteorites which came from outer space and were catapulted to earth as the result of the great meteoric display of March 24 last year and a less spectacular meteor of August 8 last year have been recovered by H. H. Nininger, Secretary of the Society for Research on Meteorites. Following the March 24 meteoric display which was witnessed from seven states of the Southwest, Mr. Nininger mapped the visible course of the meteor through the atmosphere and then stimulated searches for fragments that may have fallen to earth. Two of the fragments found had dropped to earth 35 miles before the end of the meteor's visible course, and another fragment was found 12 miles farther along the path. Ranchmen of the region are now searching for more fragments of the visitor from space. The August 8 meteor flashed over northwestern Nebraska where its meteoric fragment was found. Meteorites of both falls are almost identical in structure and composition. They seem to contain no metallic iron and are an uncommon variety of aerolite.

DINOSAURS may have evolved some of their most bizarre species as the result of a peculiar glandular disease, known as acromegaly. Acromegalic human beings become "horse-faced" giants, with huge hands and feet. The disease is caused by the over-activity of the pituitary, a small ductless gland within the skull. Acromegaly has been invoked by Dr. Richard S. Lull, paleontologist of Yale University, to account for the terrific skull sizes and the outrageous development of horns by certain species of ceratopsians, or horned dinosaurs, whose remains have been found in the Belly River Valley, in western Canada. What may have turned a disease into a driving force in evolution is uncertain: Dr. Lull conjectures some abnormality in the food available to the animals.

FORCIBLE demonstration of the gigantic scale on which the seas were run in remote times is given by a fifteen-foot fossilized herring which has just been placed on display in the Peabody Museum of Yale University. It was found near Russell Springs, Kansas, in a rock deposit that was soft sea-bottom mud when this great fish laid him down to die nearly a million centuries ago. Professor Malcolm Thorpe, of the department of geology, says that this is the most complete and probably the finest extant skeleton of an ancient fish. It has 87 articulated backbone segments, and the head retains an impression of the actual skin. It bears the scientific name *Portheus molossus*.

SCIENCE NEWS

Science Service, Washington, D. C.

TRIPLE WEIGHT HYDROGEN

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EXISTENCE of triple weight hydrogen, hitherto suspected but unproved, may be demonstrated by a sensational atom-smashing experiment made by Lord Rutherford, and Drs. M. L. Oliphant and P. Hartleck, of the Cavendish Laboratory at Cambridge, England, announced to the scientific world through the forthcoming issue of the journal, *Nature*.

Double weight hydrogen, now being studied intensively in the chemical laboratories throughout the world following its discovery in America two years ago, was both target and projectile in the new atomic bombardment. Hearts of heavy hydrogen, called deutons in America and diplons in England, were flung with hundred thousand volt energy at salts of ammonia that contained heavy hydrogen instead of ordinary single-weight hydrogen. This impact of deutons upon deutons (or diplons upon diplons, to follow the nomenclature preferred by Lord Rutherford) gave striking results.

There was enormous emission of fast protons or hydrogen hearts with energies of three million volts. Thus particles released had thirty times the energy of those used in the atomic attack. Two hypotheses have been made—either two heavy hydrogen atomic hearts reacted to give a new hydrogen variety of mass three, and an ordinary hydrogen atom. Or they formed a helium atom of mass three and a neutron.

Even if it turns out that mass three helium instead of a triple weight hydrogen is formed, this will prove to be an important discovery. No atoms of mass three have been unequivocally demonstrated in the past although vigorous searches have been made for them. The weight of ordinary helium is four units on the chemical scale on which ordinary oxygen is sixteen.

This discovery of a mass-three atomic heart and the enormous volume atomic transmutations achieved is expected to have important influence upon research on the composition of matter.

ARTIFICIAL RADIOACTIVITY

THE newest process for the production of artificial radioactivity is to bombard the light elements, boron and carbon, with hydrogen atomic hearts.

Dr. C. C. Lauritsen, R. D. Crane and W. W. Harper, of the California Institute of Technology, using their giant high voltage tube, have caused the formation of radioactive products by proton bombardment.

A few weeks ago Professor F. Joliot and Mme. Irene Curie-Joliot produced artificial radioactivity for the first time, and investigators carried the work further by producing the delayed emission of positrons by flinging deutons, the hearts of heavy hydrogen atoms, at elements.

The products now formed by proton bombardment seem to be the same as those formed when deutons are used instead of protons because their life history is exactly the same. It takes twenty minutes to lose half the activity in the case of the boron product and ten minutes in the case of the radioactivity produced in carbon.

The discoverers believe that the proton breaks up on entering the target atom and forms a neutron and a positron. The neutron escapes immediately but the positive electron is temporarily caught, thus transmuting the boron into carbon and the carbon into nitrogen. They regard this as more plausible than the capture of the whole proton because their energy and momentum equations balance most easily if the neutron escapes. Investigators want to balance their equations as eagerly as a bookkeeper wants to balance his books. This energy balance will furnish the simplest method so far discovered for weighing the neutron. Preliminary measurements give 1.006 for the neutron mass.

An interesting feature of the Pasadena experiment is the formation of active gases. The gas produced in the boron bombardment comes off quite readily, but carbon seems to want to hold on to its product unless heated rather vigorously.

THE ORIGIN OF GEYSERS AND HOT SPRINGS

GEYSERS and hot springs, such as those of Yellowstone National Park, are in reality steam-heated springs. The greater part of their water is ordinary rain- and snow-water from the ground surface, but their heat is supplied by steam seeping up from buried lava masses far beneath the earth.

This, in brief summary, is the doctrine of geyser and hot spring action set forth by Dr. E. T. Allen, of Washington, D. C., in a lecture given under the auspices of the Carnegie Institution of Washington. Dr. Allen spent seven years in scientific research on the hot-water phenomena of the Yellowstone.

Earlier theories of hot spring action, the speaker said, belonged to two opposing schools. The first held that everything discharged by a geyser or hot spring—water, steam and dissolved minerals—originated at or near the surface. The water descended through the earth until it encountered hot rock and was thereby heated. The opposing theory was that the discharge was all supplied from deep sources, the hot water being merely condensed out of some of the steam.

Neither theory is entirely true; hot springs and geysers receive contributions from both above and beneath. The importance of surface water in their formation is shown by the fact that hot springs are most abundant and flow most freely in exactly the kind of valleys or basins that favor the formation of cold springs.

Evidence that the heat source is steam released by beds of lava is supplied partly by comparative studies on the kind of steam and gas discharges that arise from lava in volcanic regions, partly by direct study of the steam and gases of the Yellowstone hot springs themselves. Besides steam, the Yellowstone vents discharge gases such as carbon dioxide, hydrogen sulphide and other products

abundant in active lava, but present only as traces in the surface rocks of the regions where these hot springs are located.

Another argument for the independence of the steam source, Dr. Allen pointed out, is that while the water discharge from the hot springs varies, the steam discharge does not. A hot spring may dwindle during a season of drought and may finally cease to flow any water at all. But when that happens it simply turns into a steam vent, continuing to discharge steam and the other volcanic gases.

THE CONTROL OF FUNGI

SETTING a thief to catch a thief is an old adage that has been given a new meaning by Dr. Conrad M. Haenseler, of Rutgers University. His experiments suggest the possibility of killing of plant disease fungi by using other fungi, just as entomologists have long fought insect pests by turning loose other insects that are their natural enemies.

Rhyzoctonia and Pythium, two genera of plant disease fungi, were used in the experiments. These are extremely destructive in seed beds, causing what is known as "damping off," a disease which kills seedlings by rotting them near the ground line. The friendly fungus used in the miniature combat within the laboratory was Trichoderma, a tiny, thread-like plant growth, microscopic in size, which is commonly found in the soil.

Dr. Haenseler and M. C. Allen, research assistant in soil microbiology at the experiment station, inoculated a sterile seed bed with the three species of fungi and then planted cucumbers. In the beds containing the friendly fungus, twice as many seedlings grew and only a slight damping off was discovered, as compared with seed beds inoculated with only Rhyzoctonia and Pythium.

Several tests were made in the greenhouse with cucumbers and with peas. In the laboratory, tests showed that in a nutrient solution in which Trichoderma had recently been grown, Rhyzoctonia and Pythium could not be made to grow. This proves that the Trichoderma, in growing, gave off or produced in the solution some substance toxic to these pathogenic fungi. That "something" is still an unknown quantity. Heating the solution to near the boiling point kills the toxic substance given off by Trichoderma. Exposing the filtrates to pure oxygen also destroys their toxic principles very rapidly.

ITEMS

A NEW heavenly object, probably a peculiar asteroid or minor planet, has come within range of large telescopes, the Harvard College Observatory has been informed by the central astronomical reporting bureau of Copenhagen. The discovery was made by L. Boyer, assistant at the Algiers University Observatory, located at Bouzareah, where intensive researches on asteroids are carried on. Boyer's object, as it is known after its discoverer, is in the constellation of Leo, the lion, nearly overhead in the late evening sky. It is twelfth magnitude and too faint to be seen even in small telescopes. It has now been sighted from America and its position has been determined by Dr. Fred L. Whipple at Harvard's Oak Ridge Observatory; Professor L. E. Cunningham at Harvard's Cambridge Observatory, and H. E. Burton at the U. S. Naval Observatory.

NINE deaths from parrot fever and twenty-five cases of the disease have caused the U. S. Public Health Service to send Dr. L. F. Badger, of the U. S. National Institute of Health, to Pittsburgh to investigate the outbreak there. Dr. Badger has been sent at the request of the Pittsburgh health authorities. The outbreak, said to be one of the most severe that has occurred in some time, originated in a Pittsburgh department store which sold birds. One of the birds from the store was sent to the federal health authorities and on examination was found to have suffered from parrot fever or psittacosis. A severe outbreak of parrot fever in many parts of the country occurred in 1930. In order to fight the disease, which was till then little known, the importation into this country of love birds and parrots, which transmit it, was forbidden temporarily. The disease subsequently affected birds in aviaries in southern California and a number of cases were reported from that source. The disease has now become rather a commonplace instead of being a novelty, and outbreaks of two or three cases are reported to the U. S. Public Health Service every few months. The outbreak in Pittsburgh seems to be much more severe.

BORROWING methods used by those who study air conditions in the upper atmosphere, investigators at Massachusetts Institute of Technology have devised an instrument for recording the temperature of the sea down to a depth of 600 feet. This instrument, built on the same principle as the meteorograph and called the "oceanograph," will be used to study ocean temperatures at various depths for the information which they give of the currents that are so important to ocean "weather." The oceanograph was developed by Professor Carl G. Rossby and Dr. Karl O. Lange, and R. D. Feiber, an expert on instruments. The instrument will be used on board the *Atlantis*, research ship of the Woods Hole Oceanographic Institution.

JUST how much nitrogen, carbon dioxide or other inert gas needs to be released in a warehouse to stop a fire can now be computed as a result of mathematical methods developed by Dr. S. H. Ingberg, of the U. S. Bureau of Standards, reported in *Physics*. His calculations also apply to the reverse situation, the flushing out of a toxic gas from an enclosure so that its atmosphere will be sufficiently pure to allow workers to enter.

A SPECIMEN of the centurio bat, a creature so rare that in the hundred years it has been known to science only a dozen specimens have been taken, has been captured by the Leon Mandel Guatemalan Expedition of the Field Museum of Natural History, according to word received from its leader, Karl P. Schmidt. The animal has white patches on its shoulders, which suggested to the Spanish scientists who first studied it the white epaulets worn by the centurions in the legions of ancient Rome.

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SCIENCE NEWS

Science Service, Washington, D. C.

DEUTERIUM

DEUTERIUM, or double-weight hydrogen, and the strange things done by the "heavy water" and other compounds containing it, engaged the attention of the country's leading chemists at a special session held at St. Petersburg, Florida, on March 27, as a feature of the annual spring meeting of the American Chemical Society. Participating in the discussion were Professor H. C. Urey and Dr. D. Rittenberg, of Columbia University; Dr. H. G. Brickwedde, of the U. S. Bureau of Standards; Professor H. S. Taylor and Drs. P. W. Selwood, Bryan Topley and Henry Eyring, of Princeton University; Drs. G. H. Dieke and R. W. Blue, of the Johns Hopkins University; Professor Fred Allison, of the Alabama Polytechnic Institute; Drs. L. C. Anderson, J. R. Bates and J. O. Halford, of the University of Michigan; Drs. D. H. Rank and G. H. Fleming, of the Pennsylvania State College, and Drs. Norris F. Hall, T. O. Jones and Everett Bowden, of the University of Wisconsin. The late Dr. E. W. Washburn, of the U. S. Bureau of Standards, pioneer in the study of "heavy water" who died recently, was represented posthumously by his colleague, Dr. E. R. Smith, who presented a report on which they had labored jointly.

Double-weight hydrogen, having achieved a separate name for itself, "deuterium," has now been given a separate chemical symbol, the capital letter D. Hitherto it has been designated by the old hydrogen symbol, H, with the added superscript of a small figure 2, which made of it a symbol which a beginning algebra student might have read "H squared." Its compound with oxygen, popularly called "heavy water," is thus designated D_2O, by analogy with the old familiar chemical symbol for ordinary water, H_2O. Chemists now refer to it not as "heavy water" but as "deuterium oxide." The union of an ordinary, single-weight hydrogen atom and a double-weight or deuterium atom is designated as the molecule HD. Drs. Blue and Dieke reported studies on these compounds, made with hydrogen from the "heavy water factory" recently established at Princeton.

Water is of course the simplest of hydrogen compounds, and "heavy water" correspondingly the simplest of deuterium compounds. But Drs. Rank and Fleming have made a beginning at synthesizing compounds of deuterium with carbon and hydrogen, opening up the series represented in the ordinary chemical world by the natural gas and petroleum compounds. Substituting one atom of deuterium for one of hydrogen in one of the simplest of these, they have produced new compounds which they call "neopentane" and "neopentane deuteride." Similarly, Dr. Rittenberg and Professor Urey have produced, with iodine, "deuterium iodide," or DI, corresponding to the old hydriodic acid, or HI.

HEAVY WATER AT PRINCETON

BY summer from 12 to 15 pounds of the purest heavy water will be available for the Princeton researches. The daily output is now 3 grams ($\frac{1}{10}$ ounce) of heavy water containing 100 per cent. deuterium (heavy hydrogen). The production cost is approximately $5 per gram.

Heavy water produced in Princeton's Frick Chemical Laboratory is the heaviest heavy water so far produced. It has a specific gravity at least two tenths of one per cent. greater than that recorded earlier by Professor G. N. Lewis, of the University of California. The Princeton specific gravity is 1.1078 at 77 degrees Fahrenheit (25 degrees Centigrade) as compared with the California value of 1.1056. The determinations were made by Dr. P. W. Selwood, using in all three ounces of heavy water which failed to increase in density after repeated processes of refinement. For this reason it is believed that pure deuterium oxide has been obtained.

Synthesis of ammonia, wood alcohol and other chemicals will be aided by heavy hydrogen researches carried out at Princeton. It was found that light hydrogen molecules will react with deuterium molecules to produce mixed molecules, with one atom each of light hydrogen and deuterium, at temperatures as low as that of liquid air, using catalysts such as chromium oxide. These results indicate that the high temperatures necessary in industrial syntheses are required, not for the activation of the hydrogen, but for the activation of the molecules with which the hydrogen has to react. If surfaces can be found as active towards these molecules as present available surfaces are with respect to hydrogen, tremendous improvements would be possible in the yields of ammonia and alcohol under much simpler operating conditions. The deuterium experiments indicate the direction which research in technical catalysis must take.

Heavy water will be used shortly in experiments upon the growth of cancer cells as a part of the extensive investigation of the heavy hydrogen twin element being directed by Professor Hugh S. Taylor of Princeton. The cancer experiments will be of "extraordinary interest," Professor Taylor predicted. They will be begun when larger supplies of heavy water are accumulated at Princeton.

PREDICTING TUMOR GROWTH

THE value of grading tumors in order to determine the outcome of cancer was discussed by Drs. Stanley P. Reimann and Clark E. Brown, of the Lankenau Hospital Research Institute, Philadelphia, at the Toronto meeting of the American Association of Pathologists and Bacteriologists.

Because of many variable factors which enter into the situation, this method can not be relied on to determine the outcome in an individual case of cancer, it appeared from the discussion. All malignant tumors, irrespective of grade, should be treated as thoroughly as possible from the moment the diagnosis is made, in the opinion of the Philadelphia physicians.

"By the grading of tumors is meant a prediction of what will happen to a patient when a tumor, usually a

malignant one, is left alone, or is treated,'' Dr. Reimann said. This is done by judging the effect of the environment, which is the patient, on the capacity of the cells of the tumor to multiply and destroy the patient, he explained. Consequently such factors as rate of growth, extent of the tumor and where its deposits are growing, are logical variables in the final equation.

Judgment as to rapidity of growth is made mostly on the degree of maturity of the cells as they appear under a microscope, and their deviation from what is known of the behavior of corresponding normal cells. The more mature the cells in a tumor, the slower is the growth of the tumor. This is in conformity with the well known facts that the cells in very early embryos are more immature than those of older ones, and that very early embryos grow much more rapidly than older ones.

On the basis of these characteristics, tumors can be graded into various classes; for instance, their rapidity of growth and their ability to spread is in direct proportion to disturbances in the ability of their cells to mature and produce a normal part. ''Since, however, the bars of environment offer varying degrees of help or hindrance to the propensities of heredity, and since definite values can not be placed upon all of the variables in this equation, it is impossible to grade tumors for the individual patient. But it can be stated in statistical form, such as: in a thousand patients, those who develop malignant tumors composed of less mature cells will succumb earlier than those whose tumors are composed of more mature cells. When treatment designed to destroy or remove the tumor is applied, such treatment will be more efficacious on the average in those individuals with tumors composed of more mature cells, because, on the average, these tumors will be of less extent and thus more susceptible of eradication.

''On the other hand, even tumors composed of more mature cells may be beyond reach of what destructive agents are used by the time they are applied, and thus those patients also will succumb. It can not always be told at the time the destructive agent is applied whether or not the entire tumor has been reached. Therefore patients can be put into groups, but it is decidedly unsafe to tell any individual patient that because he or she has a tumor composed of mature cells, that he or she will not succumb to its effects.''

VERONAL POISONING

WHY present methods of treating poisoning by sleeping powders are not more effective was explained at the meeting of the American Physiological Society when Dr. Theodore Koppanyi and W. S. Murphy, of the Georgetown University School of Medicine, reported their studies on veronal and related drugs. These modern sleeping powders cause thousands of cases of poisoning throughout the world every year.

Veronal poisoning is treated by injecting into the veins large amounts of sugar and salt solutions with the object of flushing the poison out of the body. Dr. Koppanyi and his associates found that these methods did little good, judging from their effect on dogs. Even with the best method, by which it is possible to drive out as much veronal or barbital in five hours as would ordinarily take two or three days, the improvement is slight.

In other words, methods of treatment directed toward quickly ridding the body of the poison do not necessarily mean the recovery of the patient. Dr. Koppanyi found the reason for this when he studied the action of the sleeping powders on cats and rabbits. With cats the effect of the drug increased each day although more and more of the original dose was being eliminated. These animals were unable to stand, walk or eat and showed depression when the amount of the drug remaining in their bodies was too small to cause any appreciable effect if injected into other cats. With rabbits, on the other hand, the drug was eliminated with increasing slowness so that more and more of it found its way to the blood stream, but when the amount in the body exceeded the average fatal dose, the animals were still able to stand, walk and eat.

Unfortunately, man seems to behave in the same way under the effect of veronal as does the cat. The drug is eliminated from his body in exactly the same way as from the cat's. He therefore suffers from a cumulation of effects of the drug, even after most of it has been eliminated from his body.

THE PROGRESS OF ANTHROPOLOGY

NEW, fundamental light regarding the human body, upsetting old, accepted ideas, was announced recently by Dr. Aleš Hrdlička, of the Smithsonian Institution, in an address before the Anthropological Society of Washington.

Latest researches show that every feature of the body, however tiny, has a range of variation of size, weight, or make-up which is normal. That is, instead of there being a single normal size for a bone or nerve or cell there is a broad avenue of sizes which includes the normal. The very molecules of the body may be found to vary within the limitations of what is normal.

From studies so far made along this line, Dr. Hrdlička has found that the ranges of what is normal are the same for living races all over the world. ''This is deeply significant,'' he explained. ''It shows that living men are all of one species. It shows that our fundamental characters are deeply fixed, not merely recent acquisitions, but older than the modern races.''

This new field of anthropology will require study for many years, even generations, Dr. Hrdlička said. The possibilities have been discovered now because for the first time in anthropological history material in sufficient quantities is available for study. Where, in the past, anthropologists examined a few dozen bones to decide a point, they now study not dozens or hundreds, but thousands.

Another striking and important discovery, made possible by exceptional collections in the Smithsonian Institution, is that every character of man has its own complete and unceasing life history.

''It has always been considered that human characteristics become fixed and finished when adulthood is reached,'' Dr. Hrdlička stated. ''In these new collections we have sufficient juvenile material of all stages of

growth and also fairly sufficient material showing different ages of the adult, into senility. All of this is now showing that every feature—teeth, hair, bones—changes without cessation from the beginning of life, before birth, to the oldest age. Every feature has its definite life curve or life cycle. The change may be slower and less marked in some features than in others, but it never ceases."

Anthropology as a distinct branch of science is just about a hundred years old, Dr. Hrdlička stated, in commenting on the astonishing amount of work that has been accomplished in a century toward the understanding of man. Among the important problems that remain for future solution, he outlined the following: further knowledge of fossil anthropoid apes, of human precursors of man, of man of the earlier stages; definite tracing of the origin of *Homo sapiens;* establishing more precisely the mental differences of racial and other human groups, and learning how these differences and environment affect their human culture, behavior and language.

ITEMS

INVESTIGATORS at Princeton have searched carefully for the new triple weight hydrogen (tritium) which Lord Rutherford a few days ago announced had probably been synthetically produced by bombardment experiments with deutons or the hearts of double weight hydrogen. But they are sure that hydrogen of mass 3 does not occur in ordinary water more plentifully than one part in 500,000,000. The mass spectrograph researches of Dr. Walker Bleakney and A. J. Gould also show that in the purest heavy water thus far obtained the concentration of this third hydrogen is less than one part in 50,000. Double weight hydrogen or deuterium occurs one part in 5,000 in common hydrogen here on earth.

EUROPIUM, one of the rarest of the chemical elements, weighs more than the books say it does. It has had its weight re-determined by two University of Illinois chemists, E. L. Meyers and Professor B. S. Hopkins, who reported their results at the meeting of the American Chemical Society. Because of its extreme rarity and also because it has no present known commerical use, the element has been but little studied. The re-determination by the two chemists raises the figure for its atomic weight from an even 152 to 152.3. This is something over double the atomic weight of copper, which is 63.57, but materially less than the atomic weight of gold, 197.2, and lead, 207.2.

CYCLOPROPANE, a gaseous anesthetic which is becoming popular in some hospitals because its use is not followed by nausea and also because it is relatively safe from explosion, has been prepared cheaply from certain constituents of natural gas, by three Purdue University chemists, Dr. H. B. Hass, E. T. McBee and G. E. Hinds. At the meeting of the American Chemical Society, they reported on the process by which they have lowered its cost to a fraction of what it used to be.

How the fumes of carbon tetrachloride, familiar as a cleansing agent, hookworm remedy and fire extinguisher, affect the digestion, liver and blood was reported by Dr. George M. Higgins, of the Mayo Foundation, Rochester, Minnesota, at the meeting in Philadelphia of the American Association of Anatomists. Dr. Higgins worked with white rats, letting them breathe known concentrations of the chemical for one hour daily. He watched their growth, weight and the amount of food they consumed during this period. Test meals remained in the stomach 62 hours longer than normal. Frequent hemorrhages and inflammation of the digestive tract were observed. After a single hour's inhalation of the carbon tetrachloride changes appeared in the liver. After 30 hours of inhalation cirrhosis involved the entire liver. Changes also occurred in the number of red and white blood cells and the amount of hemoglobin, anemia gradually appearing.

EVEN the ignominious plant parasite is fearsomely endowed with an "instinct" which increases its chances of success in life, according to Dr. Thorvaldur Johnson, pathologist in the Dominion Rust Research Laboratory at Winnipeg. In a report in *Phytopathology,* he shows how a germinating wheat-rust spore crosses a wheat leaf in such a way as to give it the best chance to infect the plant. The germ tube of the germinating rust "seed" crosses the wheat leaf at right angles to the veins. By that procedure the fungus has the maximum chance of arriving at a stoma or "breathing pore," the usual place for infection to take place, in the shortest possible time.

SUCH drugs as veronal and amytal when given to relieve the pain of childbirth may pass from the mother to the baby and poison the latter. Evidence of this was presented by James M. Dille, of Georgetown University School of Medicine, at the meeting of the American Physiological Society. Obstetricians observing the condition of babies whose mothers had been given these drugs have reported conflicting views. Some found the babies were normal, others found the babies showed they had been poisoned by the drug. The question appears to have been settled by the investigations Mr. Dille made on animals. Using a very exact method of determining the presence of these drugs, Mr. Dille was able to detect relatively large amounts of amytal or veronal or barbital in the unborn offspring of guinea-pigs, rabbits and cats which had received doses of the pain-relieving drugs or sleeping powders. In some of the offspring he found almost enough of the drug to produce anesthesia.

THE rate of increase in population during 1933 for the United States was less than half what it was in Japan, it is announced by the Scripps Foundation for Research in Population Problems. The United States added 6 new souls for each thousand of her population while Japan added 14 per thousand. The actual gain in numbers was also greater for Japan, amounting to 942,600 during the year, while the increase in the United States was only 797,000. Yet the total population of the United States is estimated to be 126,144,000 on January 1, 1934, as against Japan's 67,470,000.

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Science Service, Washington, D. C.

THE YALE NORTH INDIA EXPEDITION

A NEW link in the evolutionary history of man and ape has been discovered by the Yale North India Expedition. Investigation of fossil jaw-bones and teeth brought back by the expedition reveals the existence of man-like apes nearer to the main trunk of man's evolution than any living or extinct great apes previously known. The family to which these man-like apes belong could develop in several directions, some becoming more like the great apes, others approaching man.

Three entirely new genera are included among the five fossil jaws found in the badlands region of Potwar, India. One has been named Ramapithecus, after Rama, the hero of a Sanskrit epic. Another is named Sugrivapithecus, after Sugriva, king of the monkeys in the same saga. The jaw of Sugrivapithecus indicates that the animal had a well-developed chin, a sign of high evolution, according to G. Edward Lewis, paleontologist to the expedition. The chin is more like that of a primitive man than that of any living great ape. Many features of the teeth show parallels with human anatomy.

The finds tend to confirm the theory that higher primates originated in this section of the world, said Mr. Lewis. From a Eurasian center they migrated into China, Java, Asia Minor, India, Africa and Europe. No anthropoid apes or very early humans, however, have ever been found in America.

The expedition discovered many fossils of animals. Curious huge ruminants related to the modern giraffe were found. They resemble a cross between a moose and a bison and have two pairs of horns. Giant land tortoises that make the elephant tortoise of the Galapagos Islands look like pygmies were also uncovered.

Stone knives and crude scrapers used by men some 500,000 years ago, but millions of years after the era of the fossil anthropoid apes, were discovered by Professor Hellmut de Terra, leader of the expedition. With the Stone Age implements lay remains of mammoths and hoofed animals. These discoveries show for the first time that early Stone Age men inhabited the Himalayan Mountain region.

The foothills are called by Professor de Terra a "cemetery of prehistoric life," because of the fossil bones, wood and leaves embedded and preserved in the rocks.

According to Professor de Terra the Himalayan region is the most dynamic in the world, geologically speaking. It has changed from an ocean to the highest mountain land on earth, and in the strata are fossils from every geologic age in earth history. To-day, the region north of Benares is rising at the rate of six feet a century.

ANABASIN AS AN INSECTICIDE

COMBINING the possibilities of checking the ravages of certain insects against already existing crops, and of being itself a good crop for use on some of the irrigated lands of California and elsewhere in the Southwest, a new insect-poison plant has attracted the attention of pharmacologists attending the meeting of the American Chemical Society.

The poison is known as anabasin, and is especially effective against aphids, or "plant lice," which are among the hardest to kill of all insect enemies of plants, and annually do vast amounts of damage to field crops, nursery stock and shrubbery. They are particularly bad troublemakers in greenhouses.

The standard means of chemical warfare against these pests now is nicotin, made from tobacco wastes and from especially grown tobacco varieties. But the new chemical, anabasin, is said to be an even more potent aphid-killer. It will also kill other insects, although for some of these uses it is not so effective as nicotin and that other recently developed insecticide, rotenone.

Anabasin is a double discovery. American chemists, striving to make something stronger than nicotin, synthesized a compound which they called "neonicotin." At the same time, Russian chemists extracted a most efficient insect poison from a common weed bearing the classic Greek name Anabasis, and called it anabasin. A comparison of the synthetic and the natural compounds showed them to be chemically identical.

Small shipments of anabasin made in Russia have been received in New York. The U. S. Department of Agriculture chemists and entomologists have become greatly interested in the compound, and are continuing their experiments with it, with an eye to its possible usefulness against other insect pests.

Anabasis is a genus of dry-land weeds common in North Africa, Asia Minor and parts of Russia. There are about fifty species, of which only one, *Anabasis aphyllum*, has been investigated as a source of insect poison. The plant is related to such common American weeds as lamb's quarters, tumbleweed and greasewood.

While chemists and entomologists are looking into its usefulness as a source of aphid poison, botanists of the U. S. Department of Agriculture are undertaking tests to find whether it can be grown with profit in some of the warm, dry lands of the Southwest, which are similar to its native habitat.

THE CAUSE OF DIABETES

DIABETES, a death-warrant disease until the discovery of insulin about a decade ago, is not merely a matter of the proper functioning within our bodies of the pancreas in which insulin is manufactured.

Other glands of internal secretion, the thyroid, the adrenals and the pituitary, play their parts in causing and preventing the disease. Dr. B. O. Barnes, of the University of Chicago, discussed at the meeting of the American Physiological Society how these glands are interrelated.

For many years diabetes has been considered primarily a disease of the pancreas with its insulin-producing islands of Langerhans. During the last few years evidence has been accumulating that some of the other

glands of internal secretion might also be involved. For instance, experimentally-produced diabetes may be markedly improved by removal of the pituitary gland. This small structure located deep within the head has an important influence over growth and sex.

The thyroid also plays a part in diabetes. If a diabetic patient develops Graves' disease, due to overactivity of the thyroid gland, the diabetes becomes worse. Latest experiments now show that this effect is the result of the thyroid acting through the pituitary gland. When both pancreas and pituitary are removed, a mild diabetes occurs which is not aggravated by giving thyroid extract.

Just as removal of the pituitary improves the experimentally-produced diabetes in dogs, removal of part of the adrenal glands causes an improvement in the diabetic condition. It now appears that the pituitary may exert its influence on diabetes by acting through the adrenals, as the thyroid acts through the pituitary.

Considerably more experimental work must be done before these observations can be applied in the treatment of human diabetics, Dr. Barnes said, but these latest discoveries have led to better knowledge of the long-suspected interrelationship between the glands.

Research that sheds light on how the sugar-utilizing mechanism of the body breaks down in the absence of insulin, with diabetes resulting, was reported by Drs. C. N. H. Long, F. D. W. Lukens and Edith G. Fry, of the University of Pennsylvania, at the meeting of the Society of Biological Chemists. After exercise which uses some of the body's store of sugar, glycogen, which is the form in which sugar is stored, is rebuilt from lactic acid. This process goes on in the diabetic as well as in the normal animal, but at a much slower rate.

CORTIN AND ADDISON'S DISEASE

THE life-saving hormone of the adrenal gland, cortex, has for the first time been obtained in pure crystalline form and its chemical composition discovered. This important announcement was made by Dr. E. C. Kendall, of the Mayo Foundation, Rochester, Minnesota, at the meeting of the American Society of Biological Chemists.

Dr. Kendall and his associates found that cortin, as this hormone is called, has the formula $C_{20}H_{30}O_5$. Discovery of its composition means that chemists can now work toward the laboratory production of the hormone.

This hormone has saved the lives of victims of hitherto hopeless Addison's disease, the ailment in which the skin turns dark and the patient gradually wastes away. These patients have thus far had to depend on cortical extracts from animal glands. The scarcity of this material and its expense have made it impossible to treat all of them, since the treatment must be kept up continuously in order that the patient may go on living. With the discovery of the hormone's chemical structure it may be possible to manufacture it and thus increase the supply.

Besides its life-saving effect, cortin was found by the Mayo Foundation group to act as a brake on the thyroid gland. This U-shaped gland in the neck secretes a hormone, thyroxin, which stimulates the body's use of protein. When the gland is over-active and too much of its hormone is produced, it opens the throttle too wide and makes the body burn up protein too fast. People suffering from this condition are in consequence very thin. But cortin puts a brake on this process. This action is a good example of the reciprocal effect of one gland secretion on another, about which scientists are learning more and more. Sometimes these glands of internal secretion act to reenforce each other and sometimes they have an antagonistic effect on each other's activities.

THE CAUSE OF TRICHINOSIS

ANOTHER medical mystery has yielded to the persistent research efforts of science with the discovery that actual micro-organisms and not some mysterious poison thought to have been generated by them are responsible for fatal inflammation of the heart in human cases of trichinosis. This disease is produced in humans through the eating of undercooked pork in which the parasite, Trichina, is present. The discovery was made by Drs. Carl V. Weller, Glenn A. Dunlap and John C. Buhger, of the University of Michigan.

Most thorough microscopic examination of diseased heart tissue recovered from post mortem cases apparently had failed to show the presence of the encapsulated Trichina embryo, he explained, although these could be found in great numbers in muscle tissue throughout the rest of the body. Yet it was this acute inflammation of the heart tissue that caused death some weeks after infection with the organism. Hundreds of fatal cases were studied, but always with the same negative result. Thus it was assumed that the conclusions of earlier investigators were correct.

Then at this juncture a discovery was made. Medical men had been searching for the familiar, rounded, encapsulated form of the embryo. Dr. Buhger was puzzled by the presence in his microscope field of a long, slender granulated body, easily confused with ordinary tissue. He studied it closely and finally recovered a specimen of the Trichina embryo un-encysted. Further examination revealed others. But other fatal cases failed to give the same results.

Experiments on animals showed that the free embryo may be found in the heart muscles seven to fifteen days after infection, but that after this time it disappears and can not be seen in any form. This is true although the other muscles in the body may be crammed with the parasite. Nevertheless, the acute inflammation of the heart continues, and it is this condition which causes death.

THE RESULT OF STRATOSPHERE FLIGHTS

THE flyers who have recently ascended into the stratosphere were not traveling in totally unknown territory. True, no one had preceded them to such heights, but scientists working at their desks, without moving off terra firma, had already formed an estimate of conditions to be found there.

Using as a basis for their calculations such data as those obtained from observations of the way sound travels along the surface of the earth, and the way radio signals are returned from the electrified reflecting layer of the atmosphere, physicists were able to calculate the composition of the atmosphere at great heights. Their calculations have now received verification from analysis of

the samples of air brought down from a height of nearly 12 miles by observers in the Soviet balloon *USSR*.

Drs. H. B. Maris and E. O. Hulbert, working at the Naval Research Laboratory, and Dr. B. Gutenberg, at the California Institute of Technology, discovered from their calculations that the air high above the earth, as well as that near the surface, is warmed by the sun during the day and cooled by its own radiation at night. This daily variation in temperature must give rise to winds, and winds inevitably mean a mixing of the air, a stirring up that would cause the composition to be uniform. The proportions of the gases in the air remain the same, they conclude, up to the great height of about 100 kilometers or 62 miles, except for ozone, which exists in greater proportion above 30 miles than it does at sea-level.

Dr. Gutenberg has based his results, besides, on the spectrum of the auroras and on the height at which meteors appear. Furthermore, the fact that helium enters the atmosphere from the ground in such quantities that it should form a noticeable part of the stratosphere but that only traces have been observed, seems to indicate that this gas escapes from the atmosphere into the interstellar space, and the same seems to be true with hydrogen. The conclusions of Dr. Gutenberg are that we have very probably an increasing temperature in the stratosphere, beginning at a height between 30 and 40 kilometers (about 20 miles), no noticeable change of composition at least until a height of about 100 miles, no hydrogen at any height, a slowly decreasing amount of oxygen at heights of some hundred miles and, probably, small amounts of helium or water vapor on neon at very great heights. The principal gas at any height is nitrogen.

Since the samples obtained by the *USSR* showed the same proportions of oxygen, nitrogen and other gases as are contained in the air we breathe at sea-level, the physicists look upon this finding as evidence of the correctness of their theoretical predictions.

ITEMS

A DIFFUSE object, possibly a new comet, has been discovered in the southern hemisphere skies by Dr. Cyril Jackson, of the Union Observatory, Johannesburg in Africa. It is of the twelfth magnitude. News of the discovery was received by Harvard College Observatory.

A CABLE from London reports that the weight of the triple weight hydrogen isotope has been determined by Lord Rutherford the British physicist who discovered it a few weeks ago as a result of smashing double weight hydrogen atoms. It is 3.0151 on the chemical mass scale on which the common oxygen atom weighs just 16. If three ordinary hydrogen atoms come together to make the triple hydrogen atom, there is a loss of weight presumably released as energy equivalent to nearly 8,000,000 electron-volts. Lord Rutherford's estimate will be published in the next issue of *Nature*. That goldfish live normally and happily in dilute heavy water will also be reported in *Nature* by Drs. G. Hevesy and E. Hofer, of the Institute of Physical Chemistry of Freiburg. Other investigators had previously found that life processes were slowed by deuterium water and some lower animals were killed.

AN apparently new vitamin B factor, which makes rats grow, found in whole wheat by Nellie Halliday and Linnea Dennett, of the Michigan Agricultural Experiment Station, was reported to the American Institute of Nutrition meeting in New York. Animals fail to grow and develop certain nervous symptoms when this vitamin is lacking from their diet. The vitamin is not the familiar B one nor vitamin G, but resembles that known as B four.

DISCOVERY of two substances essential for life and growth were reported by Dr. William C. Rose and Madelyn Womack, of the University of Illinois, at the meeting of the American Institute of Nutrition. The two substances described by Dr. Rose are leucine and isoleucine. They belong to the chemical family of amino acids, which have been called building blocks of the protein substances in our food. There are eighteen or twenty of these amino acids. Previously four of them had been found to be indispensable food elements—indispensable because the body can not make them itself. It was found that two more of these amino acids are indispensable. The discovery is considered to be an important contribution to knowledge of nutrition.

CHLOROPHYLL, the stuff that makes leaves green, makes a good source of vitamin A, but only when taken with milk. This discovery was reported to the American Chemical Society by Professor O. D. Abbott, of the University of Florida. Fed alone, chlorophyll and two of its chemical derivatives did not help anemic laboratory rats on a deficient diet, but when the milk was added the formation of red blood cells was promoted. Xantophyll, a yellow coloring matter also found in plants, proved of no dietary value to mammals but apparently could be a substitute for carotene in keeping hens healthy.

THYMUS is capable of causing enormous precocity, Dr. L. G. Rowntree, of the Philadelphia Institute for Medical Research of the Philadelphia General Hospital, reported at the meeting of the American Physiological Society. Growth, development, maturity and fertility were speeded up at a tremendous rate in rats by doses of thymus gland extract, Dr. Rowntree and associates, Drs. J. H. Clark and A. M. Hanson, found. These effects of thymus treatment were transmitted to the offspring and were much more marked in the third generation than in the first.

CENTURY plant juice may help defective kidneys to let their owners stay alive longer is indicated by experiments of Dr. Herman D. Jones and associates, of Alabama Polytechnic Institute. These experiments were reported to the American Chemical Society meeting. Of seven laboratory animals with artificially induced nephritis, six died. Of seven others with similarly induced nephritis, but treated also with agave (Century plant) concentrate, only two died and five survived.

Three Important Revisions

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By EDWARD ARTHUR FATH, Professor of Astronomy, Carleton College. *McGraw-Hill Astronomical Series*

Offers a fundamental treatment of the whole field of astronomy. The book is comprehensive in scope, covering the principles of physics involved, the instruments and methods of the astronomer, and the principal heavenly bodies.

All data in the new edition have been corrected to the end of 1933, so far as known. The later chapters have been in part rewritten and the material rearranged and amplified. Lists of exercises have been added to the earlier chapters, the appendix has been enlarged by the addition of several tables, and over twenty new illustrations have been added.

Kinetic Theory of Gases

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By LEONARD B. LOEB, Professor of Physics, University of California

For nearly seven years this text has held a unique position in the field as the only American book of its kind. It develops the classical ideas of the kinetic theory in a simple, accessible manner, combining them with the recent experimental and theoretical advances in the subject.

In the new edition, a third of the text has been completely rewritten. The classical treatment remains essentially the same, but the sections dealing with the more recent developments have been revised and brought up to date, especially the chapters on specific heats, the equation of state, the distribution low, and the discharge phenomena in gases.

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By D. B. SWINGLE, Professor of Botany, Montana State College. *McGraw-Hill Publications in the Agricultural and Botanical Sciences*

This successful textbook presents in logical sequence the principles of plant taxonomy and nomenclature and discusses representative families of plants. The book has been thoroughly revised: much of the material has been entirely rewritten and the organization has been improved. The rules of nomenclature have been revised to include the work of the International Congress of London. The illustrations, one of the most widely commended features of the first edition, have been augmented by a number of new, original figures.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE DEPOSITION OF ZINC ON COPPER

THE discovery that the surface of polished metal is liquid promises to lead to a new method of metallic plating. This advance may result from a few seconds of startled watching of the picture thrown on a screen by an electron "microscope."

In a few fleeting moments, Professor G. I. Finch and two research students, Dr. A. G. Quarrell and J. S. Roebuck, at the Imperial College of Science, London, found definite proof of a hypothesis put forward many years ago by the late Sir George Beilby, the director of fuel research for the British Government during the world war.

Professor Finch and his colleagues were working with a special type of instrument called the electron-diffraction camera. This wonderful "camera," in which a stream of electrons throws an image on a fluorescent screen, in effect magnifies the object 30,000,000,000 times compared with the 2,500 or 3,000 times of most ordinary microscopes.

They were experimenting with a piece of polished copper, which was being bombarded with particles of zinc emitted from a zinc wire rapidly heated in a vacuum by an electric current. Many times before similar experiments had been made, study of the shapes of crystals thus deposited on metal surfaces. But this happened to be the first time that the bombarded metal had been polished.

As usual a diffraction pattern was shown on the fluorescent screen—a score or more of bright circles. But to the intense surprise of the watchers this pattern gradually weakened, became less bright and within three seconds had completely disappeared. They tried again. A second, a third and a fourth film of zinc was projected onto the copper. Each disappeared in the same way as the first, but each diffraction pattern lasted longer than the preceding one, until the twelfth pattern remained—meaning that the twelfth layer had stood fast.

"What this means," Professor Finch told the Science Service correspondent, "is that the incoming crystals of zinc were being dissolved in the liquid layer of the polished copper. Like snowflakes falling on water, the crystals rest for a moment on the surface and then disappear.

"That this should happen at all is presumptive evidence that the top layer of the polished metal is liquid. But the real proof is that with this experiment we can only observe an electron pattern when the zinc crystals are on the top of the liquid surface, and not before they arrive or after they have disappeared. No pattern means no crystals—which is what physicists call the 'solid liquid' state.

"The twelfth layer of crystals standing fast simply means that the liquid copper has reached its saturation point, has dissolved all the zinc that it is capable of holding. This is supported by the fact that when the zinc bombardment was turned on polished iron the zinc layer stood fast at only the second attempt. Zinc is less soluble in iron than in copper, and so one would expect the liquid layer of iron to be saturated more quickly."

Professor Finch has found that the films of zinc or other substances thus deposited on polished metal can never be completely removed without removing the metal itself. An alloy has, in fact, been formed. This process, which he terms "vacuum-plating" has, he believes, great commercial possibilities as a substitute for electroplating. A systematic investigation is now being started.

THE ABUNDANCE OF THE RARE GASES

WHY some elements are more abundant than others is a question that has long interested scientists because of its importance in any theory of the evolution of the elements. Certain relations to atomic numbers have been found, and many hypotheses have been proposed.

However, it does not seem to be always the most stable atoms that survive the atomic struggle for existence. For instance, Drs. W. M. Elsasser and R. Guggenheimer point out, as reported in the *Comptes Rendus* of the French Academy of Sciences, that the noble gases neon, argon, krypton, xenon, which disdain to form any chemical combinations whatever with other elements and are among the most stable of the atoms, are exceedingly rare on this earth—whereas the elements which stand on either side of them in the periodic table, the metals sodium, potassium, rubidium, caesium on one side, and the acid forming halogens fluorine, chlorine, bromine, iodine on the other side, which are chemically the most active elements known, are millions to billions of times more abundant.

By the loss of an electron from the nucleus, each gas is stepped up one atomic number and transmuted into the metal which stands next to it in the table—neon to sodium, argon to potassium, etc. By the loss of a positron, or of an alpha particle and an electron, from the nucleus, each is degraded one atomic number into the halogen just preceding it in the table—neon to fluorine, argon to bromine, etc.

Drs. Elsasser and Guggenheimer suggest that originally these gases were abundant in the earth's atmosphere, but that by millions of years of bombardment by neutrons they have been converted into these other elements, which have been incorporated in the earth's crust where we now find them in abundance, while the atmosphere has been almost completely denuded of the noble gases.

This is considered an attractive hypothesis, which in its presentation to the French Academy had the sponsorship of Dr. Francis Perrin.

HEARING SOUNDS OF DIFFERENT PITCH

THE highest notes of the violin may reach your brain in an entirely different way from that of the low rumble of the bass drum. Evidence for a dual mechanism of hearing for high and low tones was presented to the New

CAMBRIDGE UNIVERSITY PRESS

RESONANCE RADIATION AND EXCITED ATOMS

By ALLAN C. G. MITCHELL
New York University

and MARK W. ZEMANSKY
College of the City of New York

Demy 8vo., pp. xvi + 338. $5.00

A new volume in *The Cambridge Series of Physical Chemistry*. The book aims at a comprehensive account of the theories, experiments, and interpretations connected with resonance radiation. An attempt is made (1) to adopt a unified point of view, compatible with modern quantum theory, in discussing and interpreting the experiments that have been performed, and (2) to present the theoretical aspects of resonance radiation in an orderly manner with a systematic notation. Special attention is paid to the principles and limitations of various methods of studying resonance radiation; also, the existing discrepancies and outstanding problems yet to be solved are critically discussed.

THE ELEMENTS OF EXPERIMENTAL EMBRYOLOGY

By JULIAN S. HUXLEY and G. R. DE BEER

Demy 8vo., pp. xiii + 514. With 221 illustrations. $7.00

This new volume in the *Cambridge Comparative Physiology Series* contains an account of the results of the experimental attack on the problem of the biology of differentiation, i.e. the production of an organized whole with differentiated parts out of an entirely or relatively undifferentiated portion of living material. There exists in this subject a vast body of facts and a paucity of general principles. The authors have endeavored to make of these facts general principles, even when the principles seemed to be only provisional. They have deliberately restricted themselves to the early period of development, from the undifferentiated condition up to the stage at which the main organs are laid down and their tissues histologically differentiated; in other words, to Wilhelm Roux's "prefunctional period."

60 FIFTH AVENUE NEW YORK

THE MACMILLAN COMPANY

York Branch of the American Psychological Association by Dr. Clifford Pearce, of Brown University.

Dr. Pearce's experiments were based on the fact that when the ear is fatigued by hearing a tone for a period of time, the tone or others sounded will not appear so loud. But when the ear is fatigued by a high tone, the hearing of high tones is affected more than is the hearing of low tones. And, likewise, when a low note is used to fatigue the ear, the hearing for low notes is affected more than for high notes. These results indicate the likelihood of a separate process of hearing for high and low pitches.

Such a dual mechanism has been suggested as a result of research previously conducted at Harvard and elsewhere, and is a sort of compromise between conflicting theories of how hearing takes place. One theory, the telephone theory, teaches that the frequency of the sound wave, which gives it its pitch, is duplicated in the frequency of the nerve impulse in the auditory nerve. This theory fell down when it was established that the auditory nerve can not transmit frequencies as high as many of the highest audible sound frequencies.

The second theory holds that different parts of the membrane of the ear are tuned to various pitches. When a sound comes to the ear, only the correctly tuned section of the membrane vibrates, and the nerve attached to that particular section is set in action. The high tone is recognized as different from the low tone, because it comes by a different route to the brain.

The newest theory holds that the telephone theory may be correct for low tones, and the place or resonance theory for the high pitches. This dual theory was the one tested by Dr. Pearce.

MANNER OF BREATHING AND OXYGEN CONSUMPTION

SCIENCE has turned to the mysticism of India to discover new facts about breathing. For nearly two years a young Hindu graduate student at Yale University, K. T. Behanan, returned to his native India to subject himself to the practices of the cult of Yoga in the hope that psychology and physiology would be benefitted. In this scientific excursion into routine practices associated with mysticism Mr. Behanan had the guidance and cooperation of Dr. W. R. Miles, of the Yale Institute of Human Relations. Dr. Miles and Mr. Behanan presented to the American Physiological Society preliminary results for the graphic pictures of these breathing patterns and careful determinations of the oxygen used by Mr. Behanan's lungs while he performed the intricate breathing exercises taught him by a noted Yoga practitioner.

Unusual breathing methods are a part of the rigorous religious regimen of the Yoga cult which dates from the third century B. C. Extreme variation from ordinary breathing habits are learned by Yoga disciples and used daily for periods of from one to several hours.

Because peculiar breathing methods are not confined to these religious mystics but are used in sports and industry, their physiological significance may have theoretical or even immediate practical application in our modern Western world. Pearl divers often are able to hold their breath for unusual lengths of time, over-ventilating their lungs with unusual amounts of oxygen. Expert swimmers develop breathing rhythms that give them record-winning advantages.

Kapalabhati, Ujjayi and Bastrika were three of the breathing exercises learned by Mr. Benhanan and practised by him for twenty months of adherence to the Yogic routine.

The Indian mystics use Yoga breathing exercises in order to induct themselves into the proper physiologic state for beginning their particular type of religious contemplation.

Physiologists were interested in Dr. Miles's report that the oxygen consumption of Mr. Behanan during the Yoga breathing was increased about twenty per cent. over that of his ordinary breathing. This was followed by a reduction of about four per cent. during 15 to 20 minutes succeeding the exercise. This Yogic breathing was at the rate of one breath per minute or slower.

MENTAL TESTS AND AFRICAN CHILDREN

THE experience of giving mental tests to 50 Souscus children, primitive West-African Negro youngsters in the isolated all-native village of Koba, French Guinea, was described to the New York Branch of the American Psychological Association, in a report by Drs. Elaine F. Kinder, psychologist of New York, Solomon Machover, of Bellevue Psychiatric Hospital, and Henry W. Nissen, of Yale University.

The tests were given with the aid of an interpreter who had been previously trained in the technique. All sorts of difficulties were encountered, but chief amongst them was that the children, although apparently of normal brightness, simply could not comprehend what they were to do with many of the tests. These children have had very little contact with the culture of modern civilization, and the experimenters conclude that this isolation accounts for the fact that they did well on some tests, but could not even attempt others. None of the tests used was dependent upon the use of language.

In order to arrive at some sort of estimate of intelligence quotient, or the children's "brightness for their age," it was necessary to guess at the chronological age of the youngsters. No records were kept by the tribe, and although the tribal chief and the parents were questioned, they could not help much. Consequently, a combined estimate by the examiner, the interpreter, and a white mechanician attached to the laboratory was used.

The difference between the scores made by these primitive children and Negro children in the United States is to be accounted for by the vast differences between the life and culture of America and of Africa, the investigators conclude. This is confirmed by the fact that the test quotients of the younger children were consistently higher than those of the older ones.

PSYCHOLOGICAL TESTS FOR MUSICAL ABILITY

THE student fired with ambition to become a concert musician or to earn his living by playing in an orchestra, yet lacking in the certain something that makes for

success along these lines, may be saved from the bitter heart-ache of failure by tests reported at the meeting of the New York Branch, American Psychological Association, by Dr. Hazel M. Stanton, director of the musical talent service, of the Psychological Corporation.

Six tests of musical capacity and a comprehension test form the battery of examinations with which Dr. Stanton is able to classify students entering on a music course according to whether they are safe "risks," probable, possible, doubtful, or discouraged.

During the course of an eight-year study reported by Dr. Stanton to the psychologists, she had used the tests to predict the probable achievement of students entering on a degree course in a music school. She found that of the "safe" group, 60 per cent. completed the course successfully and graduated; 42 per cent. of the "probable" graduated; only 33 per cent. of the "possible"; 23 per cent. of the "doubtful"; and only 17 per cent. of the "discouraged" reached the goal. In other words, about 80 per cent. of those making the poorest scores on the test never succeed in completing their course, and naturally have very little chance of professional success after graduation.

"The students in the lowest groups are poor risks for a music degree, for themselves as well as for the music schools; they should know these facts and not be deceived," Dr. Stanton concluded. "For many of them music should be only an avocation."

ITEMS

A CONSPICUOUS spot on the surface of the planet Jupiter has been discovered by a Berlin amateur astronomer and confirmed by observations made through the great refracting telescope of the Potsdam Observatory, the central bureau for astronomical telegrams at Copenhagen has been informed. Learning of the discovery by the amateur named Kutscher, Dr. R. Müller and Professor W. Münch observed the planet with a telescopic magnification of 300 diameters. Dr. Müller reported that in spite of very bad seeing a diffuse spot could be recognized in the dark northern equatorial belt, which projected to the south and to the north of the dark belt as a conspicuous arch-like formation, so that one had in all the impression of a globular object. Under more favorable conditions of seeing further details would probably stand out.

SEARCHING for the bones of extinct animals that ages ago had become bogged down in asphalt deposits at McKittrick, Calif., V. L. VanderHoof came upon a succession of layers in the asphalt, which are comparable in a way to the annual growth-rings in trees, and may have been due to the same set of causes. The yearly bands, he told members of the Geological Society of America at their meeting in Berkeley, represent a yearly recurrence of physical conditions which are influenced by climate. Winter cold so increases the viscosity of the tar that it solidifies, while high summer temperatures render it fluid and able to flow down slope. Winter rains cause enough sheet wash to blanket with dirt the previous summer flow, thus sharply marking off one year's layer from another. Mr. VanderHoof has measured and plotted a series of 180 of these bands, and efforts are now being made to correlate the resulting curves with similar curves resulting from studies of tree rings and of varves, or layers of alternating fine- and coarse-grained lake-bottom silts.

GIANT flesh-eating dinosaurs roamed the red sands of China a hundred million years ago, seeking what they might devour. At the meeting of the Geological Society of America, Professor George D. Louderback, of the University of California, told of the identification of fossil bones found in the Red Beds of Szechwan as belonging to a great reptile of the Tyrannosaurus type. This identification helps to establish the geologic ages of these deposits, which have yielded relatively few dateable fossils. Tyrannosaurus elsewhere in the world belonged to Upper Cretaceous times, which have an estimated antiquity of ninety or a hundred million years.

WHEN giant sloths inhabited Gypsum Cave in Arizona, famous for the discovery there a few years ago of human artifacts associated with the bones of extinct animals, the climate of the region probably was much moister than it is now. This is indicated by a study of the plant fragments in the digestive waste of the animals, which was abundant in the caves. A report of this study was presented before the meeting of the Geological Society of America by J. C. Laudermilk, of Claremont, Calif., and Dr. Philip A. Munz, of Pomona College. Eighty per cent. of the refuse consisted of tissues of a species of giant yucca known as the Joshua tree. The remainder was derived from various other desert plants. This yucca species does not grow in the vicinity of Gypsum Cave to-day, but is abundant in the Clark Mountains, 12 miles distant and at about 3,500 feet greater elevation, with a more generous rainfall.

EXPERIMENTS reported by G. A. Nadson and C. A. Stern, who communicated their researches to the French Academy of Sciences, indicate that metals exert a harmful influence upon microbes and seeds even though they are not in contact with them. They first found that metal plates at a distance of one to two millimeters from certain microbes influenced the microbes. Some kinds of microbes are killed, other kinds are weakened or modified in their characteristics. Metals of high atomic weight were found to be more effective than metals of low atomic weight. Thus the order of decreasing effectiveness was lead, gold, platinum, aluminum, which is also the order of decreasing atomic weight. In another investigation, a similar effect on plant life was found. Mustard seeds that had started to germinate were exposed for three days to various metal plates distant one to three millimeters, and their growth was found to be retarded. Again the influence of the metals was in the order of their atomic weights. It has not yet been determined whether the effect is due to some kind of rays, to a metallic vapor, or to other causes.

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SCIENCE NEWS

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THE EXPANDING UNIVERSE

"NEVER believe an experiment until it is checked by theory." Sir Arthur Eddington would add this maxim to rules for the guidance of science.

Theory and experiment must evolve together, he told a group of scientific men at the University of Chicago when he discussed the latest theories of the expanding universe.

Sir Arthur told the story of the expanding universe, making the statement that the galaxies are receding with velocities proportional to their distances from us.

Velocities are determined from the Doppler effect, in this case the shifting of the spectrum lines to the red—the more distant galaxies having the greater shift. Distances are obtained from the period in the luminosity of Cepheid variables by a relationship between this period and their distance. This relationship has been checked for nearer Cepheid variables.

In 1917 Professor Willem De Sitter, of Leiden, brought forward a theory of the expanding universe which required this relationship between distance and velocity, but at that time the supporting evidence was meager; however, since then, a great deal of additional evidence has been accumulated. For galaxies 1,500,000,000 light years distant their velocities of recession are of the order of 15,000 miles per second.

What happens then with galaxies that might be so far distant that their velocity of recession should be greater than the velocity of light? Professors Albert Einstein and Hermann Weyl sumounted this difficulty which would contradict the fundamental basis of relativity by assuming a closed curved space. This spherical space is such that it would take light approximately 6,000,000,000 years to come back to its starting point.

This mathematical curved space must be equivalent to a force of repulsion which force is causing the expansion. According to Newton, gravitational forces of attraction are exerted between objects and these forces also must be taken into account, but their magnitudes are negligible except when the distances between the objects are relatively small.

In the beginning of things, Sir Arthur believes that matter was so distributed that these forces of Newtonian attraction and cosmical repulsion balanced one another, the equilibrium however being unstable. In our own solar system where distances are relatively small the Newtonian attraction has the upper hand, whereas for the galaxies the cosmical repulsion predominates and such types of equilibrium are stable. Why one or the other took precedence it is impossible to say at present.

From astronomical data the total amount of matter in the universe is 10 to the twenty-second power times the mass of the sun, or 10 to the seventy-ninth power protons and electrons. The universe thus consists of 10,000,000,000

The public does not appreciate the possible danger of contact with birds, particularly birds of unknown origin, Professor Meyer said in discussing the disease, which has been a constant menace since 1929 and which claimed ten victims in Pittsburgh last month.

Facts about parrot fever or psittacosis, little known by the public, were presented by Professor Meyer as follows:

Actual contact with or possession of parrakeets is not necessary to cause the disease. A brief visit in a room with birds or sojourn in a baggage car transporting birds may be followed by disease in persons susceptible to it.

Women are affected by the disease more frequently than men. This is partly because they are either engaged in breeding parrakeets for a livelihood or because as lovers of pets they come more closely in contact with the birds.

Not only parrots and parrakeets are susceptible to psittacosis, and consequently a possible danger, but also the canary, bullfinch, nonpareil, Java sparrow, cockateel, Bengalese, Pekin robin and even the chicken.

Young birds are the chief danger as source of the disease. Mature birds, eight months or older, are much more resistant and are seldom if at all involved in human outbreaks. Over 70 per cent. or nearly three fourths of the human cases in California and elsewhere have been caused by newly acquired shell parrakeets.

The disease may be acquired by direct contact through handling the corpse of a dead bird that died of the disease, by feathers, by excreta, by nasal discharge and through bite wounds. It may also be acquired from virus particles in the air. There is no doubt that the droppings and nasal discharges of the birds, which contain the disease-producing virus, are readily scattered by the flying motions of the birds, which are easily agitated by persons who handle or approach the cage.

The disease belongs to the class of filterable virus diseases. The specific causative agent consists of minute particles of living matter that can only be seen through a microscope and which are known as L.C.L. bodies or *Rickettsia psittaci*.

The disease has a high death rate, one out of every four or five cases ending fatally. Commenting on the difficulty of controlling the disease, in spite of adequate scientific knowledge of it, Professor Meyer said: "The majority of bird breeders, pet-shop owners, lovers of birds and even veterinarians still doubt the existence of of such a disease as psittacosis. Bird breeders and pet-shop owners whose parrakeets have caused sickness and death still declare in 1934 that psittacosis is an imaginary malady and the publicity a hysterical propaganda to injure their business."

OUTBREAKS OF ENCEPHALITIS

BECAUSE of the possible occurrence of encephalitis in other communities during next July, August and September, Dr. David P. Barr, of St. Louis, pointed out salient features of the epidemic occurring in St. Louis last summer for the benefit of physicians from all over the country assembled at the meeting of the American College of Physicians in Chicago.

Dr. Barr explained that these outbreaks, if they occur, may be of similar character and of greater or less severity than the St. Louis epidemic which involved about 1,000 of the population in that area.

One location where the disease will probably not occur next summer is St. Louis, in the opinion of health authorities. Another factor, about which little is known, but which may influence the occurrence of the disease is climate. The summer of 1933 in St. Louis was unusually hot and dry. June was the hottest ever recorded and the rainfall in June, July and August was the lowest in the history of the city. A prolonged drought followed heavy spring rains. Similar climatic conditions prevailed at the time of a similar outbreak of encephalitis in Japan a few years ago. It is not yet known, however, whether there is any but coincidental relation between climate and the appearance of the disease.

The disease is caused by a filterable virus. Blood of patients who recovered from the disease, and to a lesser extent of doctors and nurses who were exposed to it but did not get sick, contain properties that neutralize the effect of the causative virus, according to Dr. Barr.

In the St. Louis outbreak the disease was fatal in one out of five cases, but the death rate was much higher in persons over forty than in those under forty years of age. Most of the deaths were attributable in part to complications, chiefly pneumonia. Kidney disease, high blood pressure and hardening of the arteries when present before the onset of encephalitis seemed to play a rôle in lessening the chances of recovery.

One favorable aspect of the disease as it occurred in St. Louis is that the nervous changes generally following in the wake of encephalitis have not so far appeared in patients who recovered. "It is of especial importance," Dr. Barr said, "that examination of many patients three months after the epidemic showed no new symptoms referable to encephalitis and no evidence of progression of the disease."

THE TREATMENT OF MENTAL DISEASES

METHODS of treating mental and nervous diseases have been completely changed, with benefit to the patient, during the first quarter of the present century, according to a statement made by Dr. Charles Macfie Campbell, professor of psychiatry at Harvard University and director of the Boston Psychopathic Hospital, before the New York Academy of Medicine.

The spirit of this transformation in treatment of mental disease, he continued, was represented by Dr. Thomas W. Salmon, in whose memory Dr. Campbell is giving a series of lectures at the academy.

Understanding of the real forces at the basis of the patient's mental or nervous difficulty, with the view to helpful intervention, has come to be the main interest of the physicians who study and treat mental disease. Before this change in viewpoint, the classification of complicated reactions had been the main interest of psychiatrists.

Dr. Sigmund Freud, Viennese psychiatrist, and Dr. Adolf Meyer, professor of psychiatry at the Johns Hopkins Medical School, furnished the inspiration for the change in psychiatric methods and viewpoint, according to Dr. Campbell.

Dr. Freud contributed psychoanalysis, a method of detailed analysis of the personality. Dr. Meyer emphasized the life history of the patient dealing with concrete situations and described various modes of adaptation of the patient without reducing these ways, of reacting to a situation, to the components on which Dr. Freud laid emphasis.

Dr. Campbell said that "Under the influence of these two schools of thought psychiatry became much more personal and in order to carry out its task looked in every direction for material which would throw light upon the nature of the personality. In this search the greatest contribution was made by the anthropologist and by the genetic psychologist studying the life of the child directly and not through the medium of analysis of the neurotic adult."

INSECT PESTS

GOVERNMENT fighters against insect enemies of crops and orchards are getting set for a tough summer. A summary of surveys conducted during late winter and early spring shows that some of the most troublesome and wide-spread of insect pests have come through the winter with less than the normal percentage of killing, so that they may be expected to be unusually numerous this year.

Grasshoppers have been the cause of the most general apprehension, for they have worked much damage in the drier parts of the northwest during the past two or three years, and the mild winter in that region has had little effect on their eggs. One good has, however, been blown by many ill winds: in parts of South Dakota the severe winter storms, scouring ground with no snow cover, have lifted its top layer and dried out the grasshopper eggs beneath it. In other places, the same blown soil has been deposited so deeply that the buried eggs have no chance to hatch. Nevertheless, there are still plenty of eggs left.

A Western pest, the Mormon cricket, threatens serious damage in parts of Idaho, Wyoming and Montana. Two of its outbreaks are on Indian reservations. In the warmer parts of the Midwest, two serious enemies of grain, chinch bug and Hessian fly, have come through the winter with very low mortality. One of the worst of insect pests in the East, the Japanese beetle, has been protected against extreme cold of the late winter months by a thick blanket of snow on the ground, so that it has escaped the unusual losses which the low temperatures might otherwise have caused.

ITEMS

CLOSING a gap that has existed in the weights of the chemical elements, evidence for the existence of both hydrogen and helium of mass three has been found in Cavendish Laboratory researches at the University of Cambridge, by Dr. P. I. Dee. According to a report in *Nature* these hitherto unfound varieties of helium and hydrogen are created when hearts of double weight hydrogen collide. Here are two new units of matter brought into existence by the smashing of heavy hydrogen particles which only three years ago were themselves undiscovered. Tracks of water vapor left behind after flights of the particles through a cloud chamber showed Dr. Dee that from heavy hydrogen collisions there emerged a proton or heart of an ordinary hydrogen atom and a triple-weight hydrogen atom heart. They recoiled in opposite directions.

A NEW fact about cosmic rays was brought out when Dr. Victor Neher, of the California Institute of Technology, described the results obtained from instruments which recently returned from cruises around various parts of the world aggregating fifty-two thousand miles. The instruments recorded automatically for a period of several months. As the vessels on which they shipped idled in some ports the instruments busily recorded more and more data until they achieved the highest accuracy so far obtained in work of this kind. This accuracy permitted Dr. R. A. Millikan to say with certainty that in these voyages there appeared not only a latitude effect but a longitude effect as well. That is, not only did the cosmic rays show a decrease in intensity as one sails into the equatorial regions, but they also showed a decrease to a lower value in the eastern hemisphere than in the western. This effect can probably be correlated with the magnetic field of the earth, which is strongest in the eastern hemisphere. The new result is, however, so difficult to reconcile with existing interpretations that Drs. Millikan and Neher present it merely as the result of these voyages, leaving it to the future to determine whether it is repeatedly duplicable or not. The experiments were all a part of a program of Dr. Millikan which is supported by a fund of the Carnegie Foundation.

THE possibility of studying explosions under the microscope has been pointed out by Dr. A. Michel-Lévy and Dr. H. Muraour, of Paris. The quantity of explosive used must be very minute, a milligram (.015 grain) or less, and the explosive should preferably be one that leaves a metallic deposit. Nitride of lead was found suitable. From the lead pattern left on the microscope slide, the nature of the explosion can be studied. Using two specks of this substance a short distance apart and exploding one of them, the experimenters found that the second was exploded by the shock and an interference pattern was formed. When the distance apart was large, the second speck was not exploded, but merely burned by the hot gases when they arrived, and no interference pattern was formed. When the experiment was tried in a vacuum, the second particle did not explode even when quite near to the first one. The shock wave is therefore propagated by the air and precedes the expanding hot gases.

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ORGANIC EVOLUTION

"ORGANIC evolution is no longer an hypothesis. It is an experimental fact; new species have been built while we look on, and in some cases we know how they have been built." With this challenging dictum, Prof. Edwin G. Conklin of Princeton University concluded the Penrose Memorial Lecture before the meeting in Philadelphia of the American Philosophical Society.

Professor Conklin who spoke on "A Generation's Progress in the Study of Evolution," stated that more progress has been made in the solution of evolution's riddles during the past quarter century than in all previous centuries. The most fruitful field for the study of evolution, has been found in the very heart of the cells.

"Imagine" he said, "the amazement and incredulity of the naturalists of a former generation who thought of evolution only as the transformations of developed organisms under the influence of changing environment, if they could learn that to-day the great problems of evolution center in the structures and functions of the germ cells! And yet this is strictly and literally true. The germ cells are the only living bonds not only between generations but also between species, and they contain the physical basis not only of heredity but also of evolution.

"In the microscopic chromosomes which are found in the nuclei of all cells, and in the ultra-microscopic inheritance units, or genes, which lie in the chromosomes are found the causes of heredity, mutation and evolution." By the manipulation of mutations, or sudden large changes, it has been possible to create actual new species.

Dr. Conklin continued: "The most important advances of the past twenty years concern the causes of mutations, or inherited variations, which are the building materials of evolution. Among these causes are changes in the numbers and composition of the chromosomes of the germ cells and changes in the inheritance units or genes which lie in those chromosomes. In many plants it has been found that new mutations are caused by an increase or decrease of their chromosomes and in a few instances absolutely new species have been formed which breed true but are sterile with their parent stocks."

EFFECT OF X-RAYS ON THE DROSOPHILA GERM CELL

DR. JOHN W. GOWEN, of the Rockefeller Institute for Medical Research at Princeton, N. J., reported to the American Philosophical Society an increase in the proportion of males to females as a result of X-ray treatment of the male reproductive cells of the fruit fly, Drosophila.

"During development the body, due to its inheritance, may become a mosaic of cells, some normal, some abnormal, and the morbidity and mortality may increase directly with the proportion of defective cells in the mosaic," Dr. Gowen explained.

This is one of four general ways in which the genetic or inherited constitution of an organism may affect the development of a diseased condition. The other three are as follows:

An unbalance in the proportion of genes, or hereditary units, may cause death or greatly reduce the length of life.

Genes normal to a species may by a permanent change in character cause physiological and developmental processes so abnormal that death or lasting disability results.

The segregation of specific genes for susceptibility or resistance to diseases caused by bacteria or viruses may be responsible for immunity, disease or death within the population exposed to disease-causing bacteria.

Starting with these known facts, Dr. Gowen sought information on the total genetic constitution of a single organism. X-ray analysis seemed to him a method for such an investigation. Consequently he exposed Drosophila sperm cells to graded doses of X-ray and found four types of change.

Besides the increase in the proportion of males to females, he observed that a large number of the sperm cells die in a prescribed order; that many sex-linked fatal changes are produced and that a few changes in the character of the genes occur which cause changes in body form.

DISEASE-PRODUCING DRUGS

THE cause of a new, fatal disease has probably been found in amidopyrine, better known as pyramidon, widely used remedy for headaches and for relieving pain in such other conditions as sciatica and arthritis.

Pyramidon and a group of chemically related medicines also used to relieve pain seem to poison the bone marrow where some of the blood cells are formed, causing agranulopenia.

This disease has a number of aliases by which it is known to medical scientists: agranulocytic angina, agranulocytosis, malignant leukopenia, granulocytopenia, and malignant neutropenia. It starts suddenly with fever and sore throat. Some of the patients thought they were getting a cold. Ulcers appear on tonsils, tongue, gums and elsewhere, spreading rapidly. Most striking, however, is the drop in the number of white blood cells from a normal of 6,000 or 7,000 per cubic millimeter of blood to 2,000 or less. The number of red blood cells and the amount of hemoglobin, meanwhile, remain normal. Most of the patients die, in spite of vigorous treatment.

The disease was first observed by a group of German investigators in 1922. But the connection between the medicine and the disease has only just been discovered.

No cause for agranulopenia had been found up to last year. Then Drs. F. W. Madison and T. L. Squier, of Milwaukee, realized that the increase in number of cases of agranulopenia paralleled the increase in use of pyramidon with other drugs containing a barbiturate, such as luminal. They studied the records of thirteen consecutive cases and found that all the patients had been

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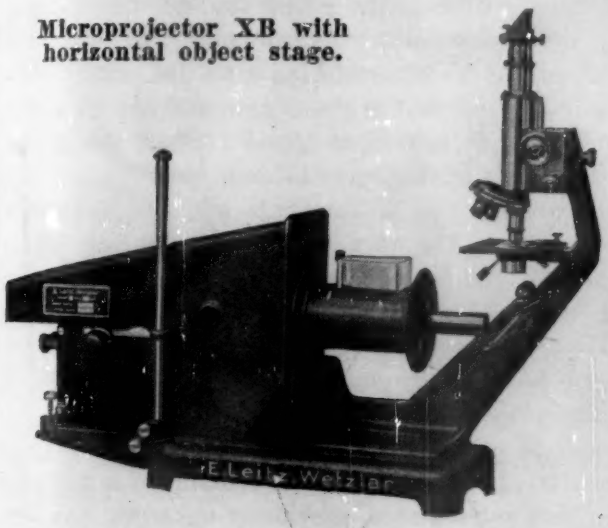

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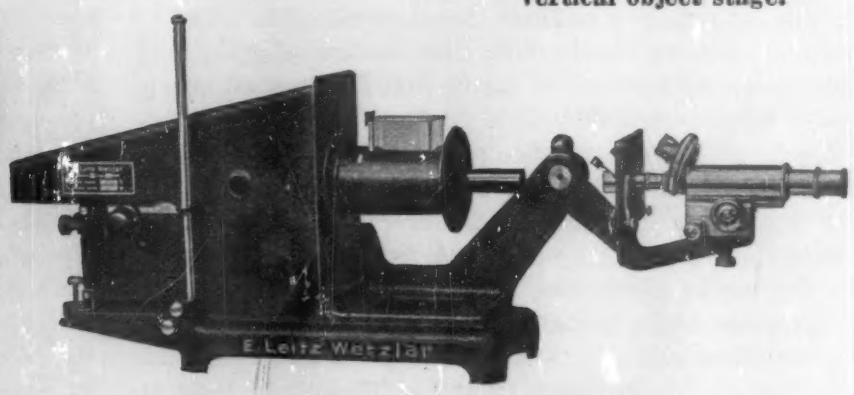

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taking one or more of these drugs over varying periods of time before the onset of the disease.

They tried giving doses of the medicine to rabbits and one animal developed the characteristic drop in white blood cells, while three others showed characteristic changes in bone marrow.

Previously, in 1931, Dr. R. R. Kracke, of Emory University, had pointed out a possible connection between the use of coal tar derivatives and attacks of agranulocytosis. He reported in the next year that eight out of nine patients having this disease had been taking drugs containing the chemical group known as the benzene ring.

Both pyramidon and the barbiturates contain this chemical group. Benzene itself has been responsible for poisoning cases in industry. Some persons seem more susceptible to it than others, and investigators of agranulopenia suggest that in this disease also individual susceptibility or idiosyncrasy may play a part.

Over fifty cases of agranulopenia developing in patients who had previously taken pyramidon with or without one of the barbiturates, modern sleeping and pain-relieving powders of the veronal and luminal group, have been reported by Drs. C. H. Watkins and P. S. Hench of Rochester, Minn., Samuel B. Grant of St. Louis, Johnson McGuire of Cincinnati, Clyde L. Randall of Kansas City, Mo., and Arthur M. Hoffman, E. M. Butt and N. G. Hickey of Los Angeles.

The use of pyramidon, either alone or in combination with other drugs, should be restricted to patients having white blood cell counts made several times a week, according to Drs. Hoffman, Butt and Hickey, in their report to the current issue of the Journal of the American Medical Association.

The danger as well as the usefulness of certain new reducing medicines, among them sodium dinitrophenol, were described by Dr. Edward L. Bortz of Philadelphia at the meeting in Chicago of the American College of Physicians. So dangerous are these medicines if carelessly used that an eminent jurist urged Dr. Bortz to recommend their inclusion in the list of dangerous drugs whose use is governed by the Federal Food and Drug law.

Three deaths have been reported in medical journals from the use of dinitrophenol, according to Dr. Bortz. In every one of these cases and in certain others, not fatal but in which other untoward effects occurred, the dosage was too strong or the drug was not correctly given. "One wonders how high the toll of deaths is going to mount when the beauty parlors and physical culture emporiums begin to pass it around," Dr. Bortz commented.

Sodium dinitrophenol and allied drugs were described by Dr. Bortz as accelerants of metabolism, the change whereby foodstuffs, water and air are adapted to the needs of the body for growth, maintenance and repair and the production of energy. This change is accompanied by heat production. When metabolism is speeded up, under the influence of dinitrophenol, for instance, more heat is produced, the surplus fat of the obese person's body furnishing the additional fuel. This results in the desired loss of weight.

With overdosage of the drug, heat is generated faster than needed and faster than the heat regulating center of the body is able to dissipate it through stimulation of the respiratory apparatus and sweat glands. The body temperature rises, up to 115 degrees Fahrenheit or higher, and death occurs from heat rigor. The body almost literally burns itself up. This was the fate of the unlucky victims of overdosage of dinitrophenol. To protect others from a similar fate, Dr. Bortz believes that the sale of this drug should be regulated so that it can be used only under a physician's directions.

ARCHEOLOGICAL DISCOVERIES ABROAD

DR. G. G. MACCURDY, director of the American School of Prehistoric Research, stated at the recent meeting of the American Philosophical Society that men of the Old Stone Age have been traced at no less than seventy places in Russia since 1921. Bones found in the Crimea, he said, add much to the understanding of what the hands and feet of Neandertal Men were like. The Neandertalers lived some 50,000 years ago, and are generally considered the forerunners of *Homo sapiens*, the species of man to which all living races belong.

China is contributing brilliantly to scientific knowledge of ancient man. The race of Peking Man, or Sinanthropus, discovered from bones and tools and hearth fires left in a cave in China, is believed to be older than Neandertal Man, but seems to have been his mental equal. Use of fire by the very ancient Celestials is a mark of their advancement.

Professor MacCurdy also cited the recent discovery on the Solo River, in Java, of skeletal remains of a new race of man. This ancient race, previously unknown, has been named *Homo soloensis*, and is considered to be a link between ancient Peking Man and the living primitive Australians.

In Palestine, British and American investigators have begun their seventh joint season of ancient man-hunting in caves near Mount Carmel. The institutions which have found these caves such profitable hunting places are the American School of Prehistoric Research and the British School of Archaeology in Jerusalem. In deep deposits, of refuse in the caves, the excavators have differentiated thirteen different stages of culture in man's slow climb toward civilization. The present season of digging, Professor MacCurdy stated, may shed more light on the earliest of the cave dwellers there, who lived 100,000 years ago in the warm interval between two of the chill glacial epochs of earth history.

THE ALASKAN EXPEDITION OF THE SMITHSONIAN INSTITUTION

ACCOMPANIED by volunteer students, Dr. Aleš Hrdlička of the Smithsonian Institution is to set out next month for an Alaskan island containing important remains of an ancient people. The young volunteers who will get their first taste of Far Northern anthropological digging include C. T. R. Bohannan from the University of Maryland, Harold E. Zickefoose from the University of Iowa, and Robert Heizer from the Junior College of Sacramento. There will probably be several others.

The site to be explored is one of the best preserved places of ancient habitation known in Alaska, Dr.

Hrdlička said, telling of plans for the expedition. The site is a high point on Kodiak Island, above reach of the sea. Portions of the site have already been excavated by Dr. Hrdlička, and this summer he hopes to complete the work.

These Alaskan expeditions, continued from year to year, have the aim of tracing early immigrations of Asiatics into America, the study of long abandoned sites of habitation in the Far North, and the search for ancient skeletal remains showing the types of men that came across Bering Strait to the New World.

The buried village at Kodiak Island is said to be very nearly unique. Digging through three separate layers of habitation, represented by bones, ashes, fireplaces and house remains, Dr. Hrdlička has already found enough to show that two distinct peoples have lived at the site. Their culture changed in radical ways. They gave up old fashions of burial. They gave up old ways of chipping stone and began to use polished stone. They gave up artistic work in stone, simplifying their workmanship, but they replaced that lost art with a new art in ivory.

The earlier people who lived at the site were cannibalistic, the evidence shows. Why they should have had this gruesome custom in a region that teemed with fish, bear, foxes, whales and other food animals is not yet explained. One curious custom noted by the anthropologist is that of burying a fox with a child. One child lay with a fox's head in its hand. Whether foxes were pets or had some funereal significance is another unfathomed mystery of the site.

ITEMS

DR. ANNIE JUMP CANNON, astronomer of Harvard College Observatory, explained at the recent meeting of the American Philosophical Society how stars, so far away that it takes their speeding light eighty-five thousand years to reach us, are being analyzed chemically, with as much accuracy as though they could be seized and thrust into a test tube. The stars are in the Large Magellanic Cloud, the nearest "island universe" outside the galaxy, or star-group of which our sun is a minor member. This extra-galactic star system has been searched, star by star, with telescopes armed with spectrographic attachments. These split the light of each star up into the various colors out of which it is blended. Every chemical element has its characteristic group of light "lines," its spectral signature or fingerprint, which can not be duplicated by any other element. Thus when the thousands of plates of Magellanic star and nebula spectra are examined, astronomers will know what these immensely distant celestial objects are made of.

WHEN a fish changes its color, as some fishes do, becoming darker or lighter according to background, the color change is impelled by a gland-like action of the nerve ends, secreting a substance called a "neurohumor." So Professor G. H. Parker of Harvard University told the American Philosophical Society. He has given much attention to this long-suspected but only recently demonstrated gland-like activity of nerve endings. In the case of the color-changes in fish, he found that there are two opposing neurohumors at work. One set of nerves secrets a neurohumor that causes the color bodies, or melanophores, to spread their pigment through their cell processes, and the neurohumor from a second set of nerves causes them to concentrate.

WORKING like ferments which are active in the making of wine and bread and the brewing of beer, the tiny hereditary units known as genes direct the development of our bodies, in the opinion of Dr. Charles B. Davenport, director of the Department of Genetics of the Carnegie Institution of Washington. If the genes are not themselves ferments, they are capable of producing in the cells of the body substances possessing the ferment property of bringing about chemical changes without themselves undergoing any change.

ANESTHETICS work by keeping our cell protoplasm from getting coagulated, as it normally does when stimulated. This, in brief, is the theory of anesthesia, presented before the meeting of the American Philosophical Society, by Professor L. V. Heilbrunn of the University of Pennsylvania. Stimuli of all kinds tend to produce coagulation in protoplasm—and the normal waking or conscious state subjects us to an endless train of stimuli, hence keeps our protoplasm always more or less coagulated. This coagulative state, Professor Heilbrunn explained, does not resemble the coagulation produced by heating so much as it does the kind of coagulation that marks the formation of clots in the blood. One way of studying the reaction in living cells is to tear them so that the protoplasm flows out. Under these circumstances, Professor Heilbrunn continued, the surface of the emerging protoplasm forms a film or clot, just as blood clots when it is poured from a vessel. In the presences of only a small concentration of calcium, fat-dissolving anesthetics like ether tend to prevent film formation. It is believed that within the cell these anesthetics act in a similar fashion to prevent the coagulative change produced by stimulation.

THE virus or "germ" of infantile paralysis may enter the body through the digestive tract as well as *via* the nasal route, in the opinion of Dr. John A. Toomey, of Cleveland. Dr. Toomey reported at the meeting in Chicago of the American College of Physicians that he was able to produce the disease in monkeys by injecting the causative virus into a part of the digestive tract from which it could easily reach the gray fibers of the nerves. He believes earlier failures to produce the disease by injections into the digestive tract were due to the fact that the experiments were not planned so as to give the virus a chance to reach the nerves before being swept out of the digestive tract.

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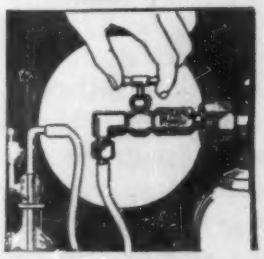

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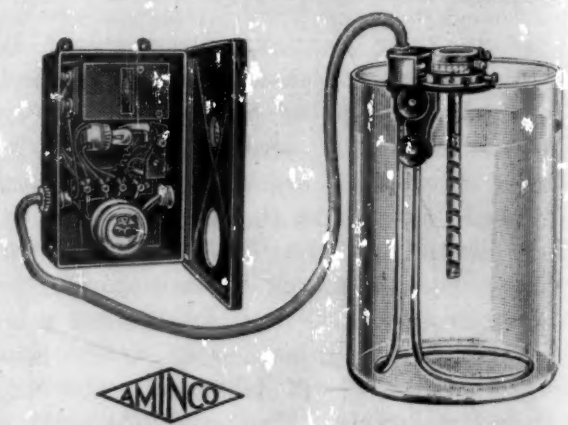

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SCIENCE NEWS

Science Service, Washington, D. C.

HEAVY HYDROGEN

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DIRECT proof of the synthesis of matter has been brought to light by the discovery of a new heavy, heavy hydrogen atom of mass three. The discovery resulted from experiments conducted by Professors Gaylord P. Harnwell, Henry D. Smyth and Walker Bleakney, all of the department of physics of Princeton University.

Through these experiments there have been found minute traces of this very heavy variety of hydrogen of mass three in a sample of almost pure hydrogen of mass two supplied by Professor Hugh Taylor, of the department of chemistry. This was accomplished by using a mass-spectrograph of very high sensitivity recently constructed in the Palmer Physical Laboratory at Princeton. This apparatus is capable of detecting one part of hydrogen of mass three in a million of mass two and in the sample analyzed actually recorded one part in two hundred thousand.

This experiment has served to prove the existence of this third isotope of hydrogen in a stable form in nature and has given an estimate of its abundance. Apparently it is present to less than one part in a billion of ordinary hydrogen.

Lord Rutherford and his associates at the Cavendish Laboratory in Cambridge, England, have obtained evidence that when two atoms of heavy hydrogen, which have a mass of twice that of ordinary hydrogen, strike one another with sufficient energy a process of atomic transmutation takes place. These two atoms of mass two probably coalesce into an unstable atom which flies apart, not as the two atoms of mass two, from which it was formed, but as one atom of mass one, which is ordinary hydrogen, and one of mass three, which is a variety of hydrogen heavier than any previously known. The evidence for the existence of this third very heavy hydrogen has been of extremely indirect nature until the completion of these experiments at Princeton. An experiment of the same nature as that of Lord Rutherford's has been performed by Professors Harnwell and Smyth. Some hydrogen of mass two was bombarded for a considerable time by more of the same hydrogen and later the resultant mixture drawn off and analyzed in the mass-spectrograph by Dr. Bleakney. It was found that after this process the ratio of hydrogen three to that of hydrogen two had increased from the original ratio of one part in two hundred thousand to about one part in five thousand. The only adequate explanation appears to be that the transmutation process postulated by Lord Rutherford actually occurs.

This recent experiment is the first instance where any atomic species has been produced artificially in sufficient quantity to analyze and detect by other than radioactive means. The continuation of this work is being undertaken by Professors Harnwell and Smyth with the purpose of producing larger quantities of this heavy hydrogen and of attempting to detect by the same method a second possible variety of helium of mass three instead of the ordinary sort with mass four. Dr. Bleakney reported the discovery to the American Physical Society meeting at Washington.

The positive discovery of the third kind of hydrogen, 300 per cent. as heavy as the ordinary kind, will rank with the discovery in 1931 that there is a double-weight hydrogen, named deuterium.

PENETRATING RAYS FROM THUNDER-CLOUDS

PENETRATING radiations resembling cosmic rays, but "softer," are thrown upward into the air from the tops of thunderstorm clouds, like spray from the tops of waves. They come to earth again to the eastward of the cloud, drawn down by the earth's magnetic field.

These radiations, which are made up of speeding negative electrons, were described before the meeting of the American Geophysical Union by Dr. B. F. J. Schonland, of South Africa, who is visiting in the United States.

Dr. Schonland states that when he began his investigations of penetrating radiations caused by lightning, he supposed that he would find electrons poured directly earthward as well as upward into the higher levels of the air; but this proved not to be the case. He has found that lightning-engendered radiations can influence cosmic-ray detecting instruments as much as a thousand miles away from a thunderstorm, and he stated that another investigator claims for them an even greater radius of action. But their effect is always felt to the eastward of the storm that gives them birth, never toward the west.

The research was undertaken with the idea of finding out whether cosmic rays were entirely the product of thunderstorms, as one student of the subject had claimed. Dr. Schonland is convinced that this is not the case; nevertheless, there are enough lightning-caused penetrating radiations to make it necessary for investigators of cosmic rays to take them into account, if their figures are not to be falsified.

THE RELATIVITY AND QUANTUM THEORIES

THE unification of the relativity theory and the quantum theory was the subject of a lecture by Sir Arthur Eddington to the National Academy of Sciences. He took the universe as pictured in formulae by Einstein and others, himself included. He took the mathematical picture of the sub-atomic world of the quanta. He brought them together.

According to Sir Arthur, it is difficult, nearly impossible, to put what he has done into words. It is a matter of expressing the constants of the universe and of gravitation in terms of the electric charge and mass of the electron. The mathematical language of astronomy is translated into the language of sub-atomic physics.

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The increasing interest in the more exact study of the functions of carotene in mammals accentuates the importance of the availability of a dependable supply of carotene of the highest purity. This interest is not only in the function of carotene as a provitamin, but also in its importance in other directions, particularly the importance of the maintenance of an optimum blood carotene level.

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NRA

One of the strange ideas used is that in the universe of relativity mass is associated with the curvature of space and that in a flat, purely Euclidian space there would be no mass or matter. To get at the mass in the realm of the quantum theory, Sir Arthur used what he called a "short cut." He determined the mass by means of the use of the famous uncertainty theory, which says that the mass of a particle can be known only if there is uncertainty about its position.

There is a limit to the uncertainty of the position of a particle in the universe even if it is totally unknown. As an analogy he pointed out that the authorities might know absolutely nothing about where an escaped criminal is located, but they can locate him within some 12,000 miles because he must be on the surface of the earth. So Sir Arthur locates the particle whose mass is desired as somewhere in the universe, with a certainty of a few thousand million light years. With this limit to the uncertainty he is able to derive without the aid of experiment values of the electron and proton that agree closely with those obtained by experiment.

The electric charge on these particles originates in the division of the universe's mass into a large number of particles, Sir Arthur explained. The charge comes when there are at least two particles and it can not exist when there is only one.

There is one incidental philosophical observation from Sir Arthur's uncertainty procedure: "You can not produce complete ignorance."

The numbers 136 and 137 bob up in the intricate equations as specially significant and interesting numbers. They are expressions of the degrees of freedom involved, the ways that things can be considered and arise from out of the properties of the particles.

Sir Arthur gave credit to Professor P. A. M. Dirac, of England, and Dr. Hermann Weyl, now at the Institute for Advanced Study, Princeton, for their work upon the problem of uniting the relativity and quantum theories.

PROTECTION AGAINST PARROT FEVER

THE heroic sacrifices of life and health made by workers in medical laboratories throughout the world have aroused universal sympathy and admiration. News that the hazards faced daily by these men and women are gradually being lessened is particularly heartening.

The latest achievement in this direction is protective vaccination against psittacosis or parrot fever, just announced by Dr. Thomas M. Rivers, of the Rockefeller Institute for Medical Research in New York City.

Seven laboratory workers have already been vaccinated. Five or six doses of live virus varying in strength from 10,000 to 10 million times the dose that will kill a mouse were injected into their muscles in order to establish in these workers a resistance to the dangerous organism which causes the disease.

Parrot fever has been particularly hard on laboratory workers who promptly met the challenge of this new and mysterious malady when it broke out all over the world in 1929, following the distribution of diseased parrots from Argentina and Brazil in that year.

Eleven cases developed at the U. S. Public Health Service's National Institute of Health in Washington. Nearly twenty more have been reported from laboratories throughout the world. The valiant work of these and other investigators has enormously increased the scanty knowledge of the disease held prior to 1929.

Now as a crowning touch comes vaccination against it for the laboratory workers, at least. With protection achieved for these key men in the fight against the disease, means of protecting the rest of the population, particularly bird-fanciers, pet-owners and pet-shop salesmen who are most exposed to the danger, may be expected to follow soon.

It is not so long since vaccination against dreaded yellow fever was achieved by Dr. W. F. Sawyer and associates of the Rockefeller Foundation. As a result, the group of men and women investigating this disease in its tropical breeding places, and also explorers, missionaries and others whose busines takes them to the yellow fever zones of the world may be assured of protection.

Rocky mountain spotted fever is another highly fatal malady that has taken a high toll among laboratory workers. Protective vaccination against this has been achieved by officers of the U. S. Public Health Service. Here, as in the case of yellow fever, and presumably psittacosis for the present, vaccination of large populations is not practicable but at least those most in danger of contracting the disease in the course of their daily occupations may be protected.

CLIMATE AND CULTURE

SEA-TEMPERED winds from the cool northwest hold people to a high level of efficiency, make for rapid reproduction and stimulate ambition.

Climates like those of the sea-fronting nations of northwestern Europe, and of the northeastern United States and the Puget Sound region, were held up as best for the development of a high civilization by Dr. Ellsworth Huntington, research associate in geography at Yale University, in an address before a sectional meeting of the American Chemical Society.

"The best condition for man is summer weather with an average day and night temperature of about 64 degrees, which means up to 70 or more by day. This is the best temperature for physical health. Although we are unconscious of it, the birthrate shows that reproduction takes place more rapidly at this temperature than at any other.

"But among people who live as we do, mental activity is greatest when outdoor temperature averages much lower. Even though we work indoors, the outdoor temperature affects us so that we work best in weather averaging about 38 degrees, that is, when there are mild frosts at night.

"Temperature is by no means the only factor in producing the climatic optimum. We need plenty of atmospheric humidity except at high temperatures. Then, too, we also need plenty of variability from day to day, although great extremes are not desirable.

"It is perfectly possible that some day the progress of invention will cause a still colder climate to have the

most stimulating effect. Or perhaps a new knowledge of how to create the right conditions in tropical countries may make the warmer regions far more stimulating and healthful than is now the case. Nevertheless, for the present there is no reason to think that there will be any radical change."

THE THYROID GLAND AND ITS PART IN HEART DISEASE

THE pain of angina pectoris and congestive heart failure may be relieved in some patients immediately after operation for complete removal of the normal thyroid gland, Dr. H. L. Blumgart, of Harvard Medical School and Beth Israel Hospital, Boston, reported at the meeting of the American Society for Clinical Investigation.

Surgeons should not be misled by this immediate relief of pain, since its cause is temporary. Permanent relief is not possible until there has been time for the metabolic rate to be reduced as a result of removal of the thyroid.

This now famous operation was devised by Dr. Blumgart and Drs. S. A. Levine and D. D. Berlin to lessen the load of the overworked heart or weakened arteries in pumping and carrying the mass of blood to the tissues. The amount of work the heart must do depends primarily on the call of the tissues all over the body for oxygen. This in turn is governed by the thyroid gland which determines the metabolic rate or the rate at which the body processes requiring oxygen go on.

When this rate has been reduced consequent on removal of the thyroid, permanent relief of the pain is achieved, but until tests show that the rate has been lowered, patients should be kept at rest in bed, in spite of the fact that they feel much better.

This permanent relief was expected to follow complete thyroid removal, but relief was experienced by the patients much sooner than expected. Dr. Blumgart and Drs. A. A. Weinstein, D. Davis and J. E. F. Riseman have spent over a year studying this aspect of the treatment. They found that the immediate relief was due to the fact that the surgeon, in removing the thyroid gland, interrupts nerve pathways which carry painful sensations from the heart to the central nervous system.

"With this early relief that occurs before the metabolic rate becomes lowered there is probably no fundamental change in the heart condition," Dr. Blumgart explained. "So the importance of keeping patients in bed after the operation, in spite of their sense of well-being, until the metabolic rate falls, is to be emphasized."

ITEMS

SUN-SPOTS, which are beginning to freckle the sun's face again after a season of relative scarcity, appear to have an intimate connection with the occurrence of sharp fluctuations in the earth's magnetic field, causing trouble with telegraphic instruments and other upsets. So A. G. McNish, of the Carnegie Institution of Washington, stated, in the course of an address before the annual meeting of the American Geophysical Union. "When sun-spots are most numerous, magnetic storms occur most frequently," he said. "The storms temporarily change the earth's magnetism. After the storms are over, the earth's magnetism returns to its original condition, for which reason it is not possible to attribute the gradual long-time changes to the action of the sun." There appears to be some relation between sun-spots and the aurora borealis, and in turn between these dancing northern lights and the electric currents that flow through the earth. W. J. Rooney, also of the Carnegie Institution, discussed these phenomena. The most brillian auroral displays are ordinarily accompanied by the strongest electrical effects. At such times the currents are noted at observatories far to the south of the Arctic regions, and even on the magnetic equator itself.

RAIN brings down radium, washing it out of the air, G. R. Wait and A. G. McNish, of the Carnegie Institution of Washington, told members of the American Physical Society. But you need not go out with a bucket the next time it rains, for the quantity is exceedingly minute—to be measured only with delicate instruments that tell of the electrified or ionized state of the air. With such an instrument in the open near their laboratory, it was found that as the rain began the ionization of the air increased rapidly, to fall off again when it stopped. The decrease with time was of such a character, they said, "as to be explainable by assuming that decay-products of radium, principally radium B and radium C in equilibrium with it, are carried to the earth's surface by the rain.

BEFORE the meeting of the American Meteorological Society, J. B. Kincer, of the U. S. Weather Bureau, cast strong doubt on the hopes entertained by some of his fellow investigators that long-range weather forecasting may be made possible on the basis of cyclical or recurrent changes, possibly connected with sun-spot cycles. The Weather Bureau has made careful and open-minded tests of these methods, he said, but the results were "keenly disappointing. The matter is still being given consideration," he continued, "and claims made by persons not associated with the bureau are carefully and openmindedly investigated, but so far with no promise of success."

THE life span of cut flowers can be lengthened by keeping them in copper containers. This is the discovery reported by John Ratsek, floriculturist on the staff of the New York State College of Agriculture. Mr. Ratsek used in his experiments containers which are copper-plated with a recently invented electro-plating finish. He found that the copper added from one to three days to the life of roses, snapdragons, stocks, delphiniums, primroses, carnations and other popular varieties of cut flowers. In one test, poinsettias in the copper container lasted sixteen days, as compared to eight days for poinsettias in a tin container. In accounting for the copper having this effect, Mr. Ratsek explained that tests showed some of the copper from the plated containers dissolved in the water. The copper thus kept the water purer by hindering growth of bacteria and other organisms which cause flowers to decay.

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SCIENCE NEWS

Science Service, Washington, D. C.

THYMUS GLAND AND SEXUAL MATURITY IN RATS

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ONCE the most mysterious part of the body, the thymus gland, which is closest to the heart of any of the endocrine organs, is now proved surprisingly to develop sexual precocity and speed up growth.

Dr. Leonard G. Rowntree, formerly of the Mayo Clinic, since 1932 director of the Philadelphia Institute for Medical Research, uncovered this hidden effect of the thymus. He followed a lead given by Dr. Adolph M. Hanson, of Faribault, Minnesota, who in time snatched from a busy practise made an extract of the thymus gland and reported that it seemed to lower blood pressure in the animals with which he worked. Dr. Rowntree was investigating this effect in rats when he discovered sexual and growth effects.

Injected daily with drops of powerful thymus extract, rats are affected markedly. Not so much the rats that first receive the injections, except that their families were more numerous. And their children's children, also treated with thymus extract, show little effect. But in the third generation, and in the fourth and fifth generations, sex came rushing earlier with more force, and size and growth were extraordinarily developed at early ages. The great grandratdaughters were rushed into parenthood by the physiological push of the thymus treatment. A third generation rat became a mother at 42 days and a fourth generation rat became a father at 29 days. They were correspondingly big and well-developed. Rats without benefit of thymus do not become parents until 50 to 70 days old.

An ounce-weight pinkish mass in the upper chest of children, the thymus has hitherto interested physicians principally because it sometimes chokes little babies to death. It dwindles to seeming insignificance when the boy or girl develops the sexual attributes of maturity. Numerous earlier investigations had failed to show a function of the thymus gland.

All animals from primitive fishes up to and including man have thymus glands. Calves' thymus glands are sweetbreads. It is from these that the Hanson extract is made. But you can eat this table delicacy without any worry that it will be forcing your grandchildren and great-grandchildren into early parenthood. Scientists long ago tried feeding thymus gland material to animals without any results.

Sexual precocity is perhaps the most striking effect of Dr. Hanson's thymus extract but general growth and development of the rats are also dramatically forced and they are unusually gentle and easy to manage. The third generation of the thymus-treated rats weighed a third again as much at birth as the average newborn rat. They could hear and they cut their teeth on their second day of life. By the fourth day their eyes were open and their bodies completely covered with hair. And they mate and bear offspring at a third of the age of their grandparents.

Dr. Hanson who prepared the potent thymus extract had previously given to the world a powerful extract of the parathyroids, tiny glands in the neck which govern bone formation. Because his extract was reported in a little-known medical journal, Dr. J. B. Collip, of McGill University, was credited with having first extracted the parathyroid gland hormone. But Dr. Hanson was able to prove his claim to priority and was awarded a patent for his product. Unselfishly sacrificing his chance for personal profit in the interest of the advancement of science, he assigned to the Smithsonian Institution in Washington all income and royalties accruing to him under the patent.

Three years ago Dr. Rowntree, then at the Mayo Clinic, gave the first dose of cortin to a human patient suffering from then-hopeless Addison's disease. His clinical use of the hormone extracted at Princeton University from the adrenal gland cortex was the first application of this important substance for the saving of human life.

VITAMINS AND HORMONES

DISCOVERIES of new vitamins and further effects of gland hormones were predicted by Dr. E. V. McCollum, of the Johns Hopkins University, and Dr. Oscar Riddle, of the Carnegie Institution of Washington, who on May 3 were presented with gold medals of the American Institute in recognition of their researches.

"There is little reason to doubt that at least one new fat-soluble vitamin remains to be discovered," Dr. McCollum said, "and probably at least two more water-soluble vitamins exist."

Dr. McCollum discovered vitamin A in 1913, and since has been a leader in nutrition research.

Dr. Riddle said that all the main elements of hormonal control of reproduction appear now to be known. He emphasized the fact that the women of the present generation are the first who could possibly know and learn the basis and the meaning of the cycles and adjustments which are peculiarly theirs. Not one of the four hormones chiefly involved in human or animal reproduction had been separated or assayed twelve years ago and the most recently separated is less than three years old.

Dr. Riddle, working at Cold Spring Harbor, New York, extracted the prolactin hormone from the anterior pituitary gland, demonstrated the thymovidin hormone of the mysterious thymus gland, and has done other important glandular researches.

Many new and spectacular researches in nutrition will come to light during the next ten or twenty years, Dr. McCollum believes. The recent discovery that paprika is a rich source of ascorbic acid or vitamin C suggests that research among plants of unusual or specialized structure may prove fruitful.

Sodium, calcium, magnesium, chlorine, iodine, phosphorus, sulfur, iron, copper and manganese are known to be indispensable in the diet. Yet with the exception of calcium, phosphorus and magnesium very little is known of the rôles played by these essential substances.

Important as are the applications of discoveries in nutrition to human health and wellbeing, as in the prevention of rickets, beri-beri, infantile scurvy and pellagra, Dr. McCollum foresees other advantages to be derived from them. Profits from the raising of farm animals may be increased enormously by applying present knowledge of proper feeding.

Failure to apply the facts already known about food needs and hormones is so great as to be humiliating, in Dr. Riddle's opinion. He blamed the schools for not giving a proper and sufficient introduction to scientific subjects, saying that biology was better taught thirty years ago than it is to-day.

THE VELOCITY OF STAR LIGHT

KNOWING the velocity of the earth in its orbit around the sun, the velocity of light coming to us from a star can be measured by observing the change in the Doppler effect when the earth in its orbital motion is approaching, and when six months later it is receding, from the star.

This Doppler effect is the shift of spectrum lines toward the blue when a source of light is approaching the observer, and a shift toward the red when the light is receding. The analogous effect in sound causes the whistle of a locomotive to sound shriller when the train is approaching than when it is receding.

Of course, it makes no difference whether the light is approaching the observer or the observer approaching the light. Ordinarily the Doppler principle is applied to determine the velocities of stars toward or away from the earth, assuming the velocity of light to be known. Conversely, the velocities of the approaching or receding bodies being known, the principle can be applied to measure the velocity of light.

The principle was so applied recently by Dr. P. Salet, and his results reported to the French Academy of Sciences. Using several stars, he found in every case a velocity slightly higher than Michelson's latest figure for light from a terrestrial source. On the average the excess was 0.8 per cent., but varied considerably with different stars.

The accuracy of this method can not compare, of course, with that of Michelson or of other terrestrial measurements. The probable error was on the average half that of the observed excess, in other words, 50 per cent. Hence it is problematical whether the excess really exists or not. Dr. Salet points out that Delambre, who redetermined the velocity of light by the eclipses of Jupiter's moons—the method by which Roemer originally discovered the finite velocity of light in 1675—obtained a velocity one per cent. greater than the terrestrial measurements.

The latest measurements of the velocity of light made last year at Pasadena by means of Michelson's mile-long vacuum tube showed curious periodic variations that seemed to be connected with the earth's rotation or motion.

In 1927 M. de Bray in an article in *Nature* pointed out that each succeeding measurement of the velocity of light, with one exception, had given up to 1926 a result less than the previous one, and drew the conclusion that this supposed absolute constant was actually diminishing with time. He now finds his conclusion confirmed, as he again reports in *Nature*, by the two measurements that have been made since that time. Thus, Michelson's measurement at Mount Wilson in 1926 gave 299,802 kilometers per second. A highly accurate measurement by Karolus and Mittelstaedt in 1928 gave 299,778 kilometers. The vacuum tube in 1933 gave 299,774 kilometers. M. de Bray consequently feels quite confident that his hypothesis has been confirmed and that the velocity of light has actually been diminishing since 1900 at the rate of about 4 kilometers per year.

The verdict of science on this is not yet rendered. But up to now, physicists have been inclined to attribute all such variations to unknown sources or to error. The fact remains, however, that they have never been explained, and sometimes important discoveries lurk in just such unexplained residuals.

ITEMS

A LARGE white spot on the planet Jupiter has been sighted by Professor J. J. Nassau, of the Warner and Swasey Observatory. It is an outstanding mark on the south equatorial belt and it is 20,000 by 2,000 miles in size. It makes an angle of thirty degrees with the planet's equator.

A LARGE reduction in the tuberculosis death-rate during 1934 is foreseen by statisticians of the Metropolitan Life Insurance Company who have been studying the mortality figures for the first quarter of the year. They expect the death-rate from this disease among the industrial population to run about 60 per 100,000 for this year. For the first quarter of the year the rate among insured white persons was 51.2 per 100,000, a "remarkably low figure."

RECENT calibration and test of instruments reveal that a true wind velocity of 164 miles per hour has been recorded on the top of Mount Washington during the present occupation of the peak as a meteorological observatory. Examination of records at the U. S. Weather Bureau show that this is an unusually high figure in the history of weather observation. A reading of 186 miles per hour was made on Mount Washington on January 11, 1878, with a hand anemometer which was held out of a window, C. F. Talman, of the weather bureau, states. Since anemometers of that day ordinarily read high, yet this one was not held in a well exposed location, its reading has been accepted as being approximately correct. Equally high and higher wind velocities are known to occur in tropical storms, but seldom does a record come through the destruction they cause. A 164 mile per hour reading was reported from Nassau during a 1929 hurricane. The present Mount Washington record was originally reported as 152 miles per hour, but the figure was altered by wind tunnel tests on the anemometer after it had been brought down from the mountain. The readings were taken between three and four A. M. last April 5.

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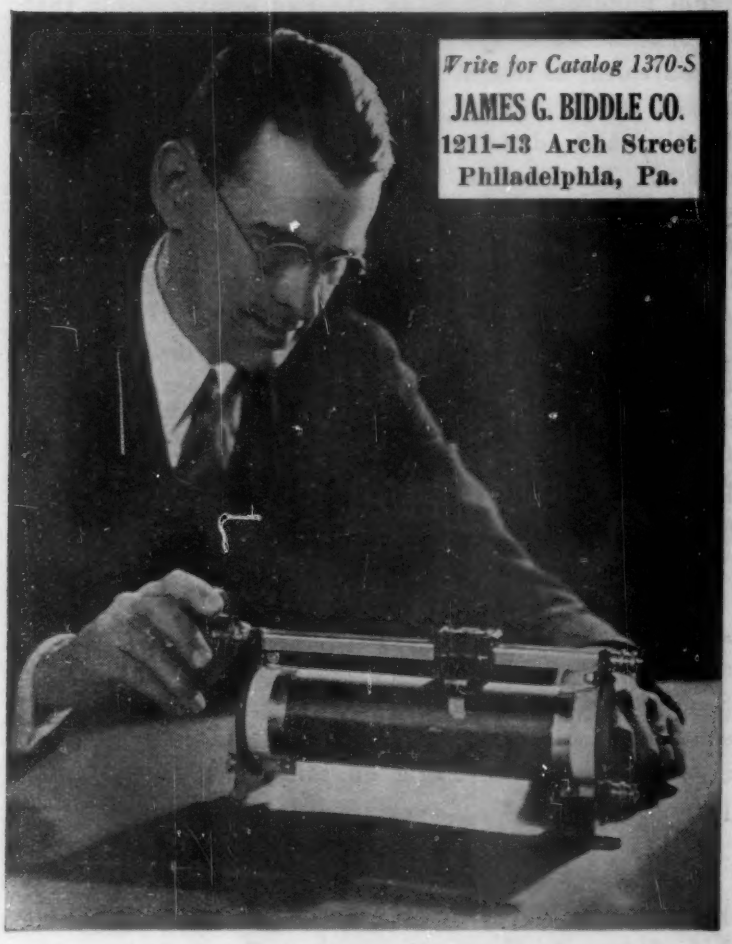

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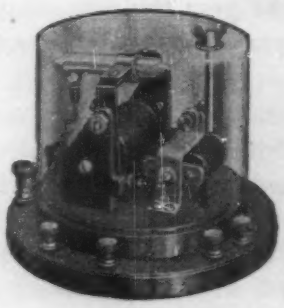

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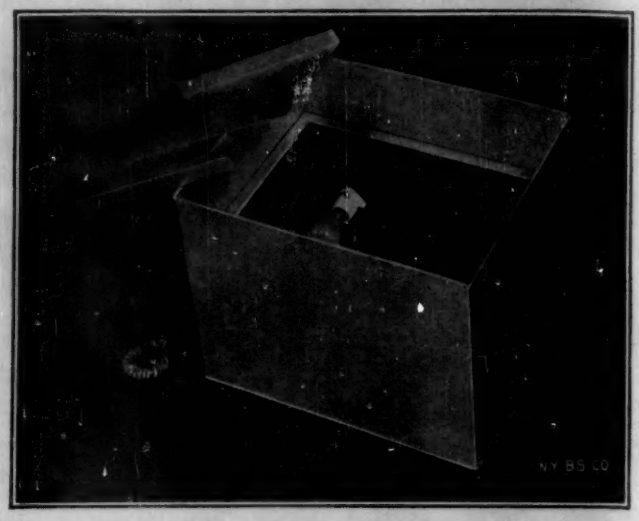

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SCIENCE NEWS

Science Service, Washington, D. C.

THE NEW TELESCOPE AT THE U. S. NAVAL OBSERVATORY

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THE new telescope of the U. S. Naval Observatory, with its 40-inch diameter mirror, made by George W. Ritchey, will photograph a larger area of the sky than some telescopes that have larger mirrors. Mr. Ritchey and his assistants are now engaged in making photographic exposures to determine just how the new instrument performs. The telescope is designed especially for photographic observation.

Captain J. F. Hellweg, superintendent of the U. S. Naval Observatory, considers that the telescope is now complete and he expects that it will soon go into active service adding new knowledge to astronomy. It is the first air-cooled telescope. This most modern accessory is not for the comfort of the astronomers who will use the telescope, but to assure better observations.

The entire observatory building is built of very light metal, with double walls, so that at night the temperature will soon become the same as the surrounding air. With more massive buildings, the stone and brick absorb heat all day, and give it off long into the night, producing objectionable air currents which spoil the clearness of the telescopic images. In order to keep the telescope at its nighttime temperature, a felt canopy will be placed over it in the daytime. This is connected with air cooling equipment, so that all day the telescope will be kept at the temperature expected that night.

The entire tube of the telescope is constructed with a unique system of counterpoises, so as to prevent bending. Convenience of the observer is also remembered, as he is provided with a movable observing platform which automatically keeps him at the eyepiece as the telescope turns to compensate for the rotation of the earth. Thus he does not need to interrupt his work frequently to adjust himself.

The curves to which the mirrors are ground are novel. In a reflecting telescope the light from a star falls on a large concave mirror. It is then reflected to a smaller convex mirror above, thence back, through a hole in the large glass mirror to the eyepiece or photographic plate. With conventional reflecting telescopes, the large mirror is ground to the shape known as a paraboloid. Such a shape has the disadvantage of a very small field, that is, the star at which the telescope is directly pointed may be focussed sharply, but others near-by are fuzzy. In astronomical photography it is desirable to have stars focused sharply over a larger area, and this can be accomplished by grinding the mirrors to new curves. These have been developed by Mr. Ritchey in collaboration with Henri Chrétien, French optician, and so the new instrument is known as the Ritchey-Chrétien telescope. The Naval Observatory installation is the second to use these curves. Several years ago, while in France, Mr. Ritchey constructed one with a 20-inch mirror, which is now in the possession of the Duc de Gramont.

THE SIZE AND SHAPE OF GALAXIES

WE live in a great ball of stars and not in a watch-shaped stellar galaxy as astronomers have supposed. Dr. Harlow Shapley, director of Harvard College Observatory, in delivering the Darwin lecture in London, said that there is now increasing evidence that some types of stars are so distributed as to make the Milky Way galaxy nearly spherical.

Our neighbor galaxy, the great nebula in Andromeda, is also a great ball of stars. As in our own Milky Way, the greatest portion of Andromeda stars fall into an elongated flattened spiral form with long diameter about four times the short diameter. When Harvard astronomers made measurements along the lesser axis with an instrument sensitive to very fine differences in light, it was found to be about five times as long as previously shown on photographs made with large telescopes.

Ideas of the sizes of our own and other galaxies of stars must be revised upward, according to Dr. Shapley. The dimensions of spiral nebulae must be increased by six tenths, and for other nebulae that look like great balls the dimensions must be tripled. It is now known that it takes light at least 75,000 years to cross our Milky Way.

Some 115,000 new galaxies were discovered on photographs made at Harvard's South African Station and at the new Oak Ridge, Massachusetts, observing point of the Harvard Observatory. The most recent photographic plate taken, exposed three hours through the 16-inch Metcalf telescope, showed 1,700 galaxies, the richest region yet discovered during the extensive Harvard survey of northern skies for new "universes." Great clusterings of galaxies, each consisting of tens of thousands of galaxies and each measuring a thousand quintillion miles across, have been found.

DIAGNOSTIC TESTS FOR TUBERCULOSIS

AN improved test for tuberculosis, discovery that the disease is less prevalent in the United States than generally supposed, improvement in taking x-ray pictures of tuberculosis patients—these are the major advances in the fight against the white plague discussed at the meeting of the National Tuberculosis Association.

The improved diagnostic aid is a new kind of tuberculin used to detect the presence of tuberculosis. One difficulty with tuberculin tests in the past has been the fact that a number of different kinds of tuberculin were used. Not all of them were reliable. Tested with one product, a person might be found free from tuberculosis, whereas a test made with another tuberculin might show the presence of tubercle bacilli in his system.

The new tuberculin, prepared by Dr. Florence Seibert, of the University of Pennsylvania and the Henry Phipps Institute, Philadelphia, was described at the meeting by Dr. Esmond R. Long, of the same institution. This tuberculin is considered more accurate and otherwise superior to products previously used.

The Medical Research Committee of the National Tuberculosis Association has persuaded two drug firms to manufacture this product and hopes to have it universally adopted for tests. This would make the diagnosis of tuberculosis more certain. It would also enable health officials to determine accurately the amount of tuberculosis throughout the country.

Tuberculin tests sift out the persons who have tuberculosis from those who have not. But after the disease has been diagnosed further examinations must be made to determine the extent of the disease and the kind of treatment needed.

Most important in this respect is the x-ray picture. Here again wide variation in the way the pictures were taken made it difficult for physicians to compare pictures and judge the extent of the disease. The Medical Research Committee, under the chairmanship of Dr. William Charles White, of Washington, has sponsored research to improve x-ray picture-taking and is trying to have the improved method here also made the standard throughout the country. Tuberculin tests are already being made on a large scale, Dr. Long reported. An entirely new view of the situation in the United States has appeared as a result. Fewer persons are infected with the tubercle bacilli, with or without symptoms of actual disease, in the West than in the East. The number of persons so infected is steadily decreasing in both sections.

Contrary to general belief, very many adults are entirely free from tuberculous infection. It used to be thought that by the time a person had grown up, he had many tubercle bacilli or germs in his body, the result of picking up a few at a time from chance contact with tuberculosis patients. Because he got the germs in small, repeated doses, he developed a resistance to them which kept him from getting ill with tuberculosis. The tests now being made in schools and colleges all over the country indicate that adults generally are not infected with the tuberculosis germs.

ITEMS

VITAMIN C, the scurvy-preventing constituent of many fresh fruits and vegetables, may help the body in fighting tuberculosis, it appears from studies reported by Drs. Eugene de Savitsch and his associates, J. D. Stewart, Louise Hanson and E. N. Walsh, of Chicago, at the meeting of the National Tuberculosis Association. Guinea-pigs given about a third of an ounce of freshly prepared orange juice daily were better able to withstand the disease induced by fatal doses of tubercle bacilli or germs than pigs equally infected with tubercle bacilli but not getting orange juice. The study was undertaken in order to determine whether the peculiar resistance of rats to tuberculosis is correlated to the fact that they can manufacture their own vitamin C and need not depend on a dietary source of this vitamin.

SCIENTIFIC ingenuity has found a way to measure continuously the tiny amounts of perspiration secreted second by second. This news befitting the approach of hot weather was announced before the Midwestern Psychological Association by Dr. Chester W. Darrow, of the Behavior Research Fund and the Institute for Juvenile Research of Chicago. "We have been able to measure in milligrams per second the perspiration secreted in limited areas on different body surfaces," said Dr. Darrow, describing the apparatus and method.

A PREHISTORIC animal with a nearly flat body and head, but with tall bony processes growing out of its backbone, has just been pieced together from fossil fragments in the American Museum of Natural History by Dr. D. M. S. Watson, professor of zoology in the University of London, now visiting the American Museum of Natural History. In front view this bizarre creature would have looked like an inverted T. It is about two feet long and the "fin" along the back is nine or ten inches high. Its name is *Platyhystrix* and it belongs to a very ancient group of amphibia that crawled along the slimy pond bottoms of the southwest 220,000,000 years ago.

AVIATORS need to take along carbon dioxide gas as well as oxygen when they fly at high altitudes, it appears from studies carried on at the Eppindorfer Hospital, Hamburg, Germany, by Professor Hans Winterstein, of the University of Istanbul (Constantinople). The chief effects of high altitude are increase in the pulse rate, in the breathing rate, in the blood pressure and enlargement of the heart; a decrease in capacity for exertion; and a decrease in the carbon dioxide in the blood which causes a subdued breathing. This last effect continues for some time after the normal air pressure is reestablished. Of all these, only the high pulse rate and fast breathing are due to lack of oxygen. They alone were eliminated when the oxygen supply was increased without increasing the atmospheric pressure. Professor Winterstein therefore concludes that the lack of carbon dioxide, while not the cause of all the symptoms experienced at high altitudes, is nevertheless an important factor that should not be neglected. The studies have just been reported in *Forschungen und Fortschritte.*

A FOOTBALL bladder strapped to his chest has kept an almost completely paralyzed patient, S. Crosby Halahan, breathing continuously for the past six months, it appears from a report by Dr. Phyllis Tookey Kerridge, of the London School of Hygiene to *The Lancet.* Dr. Tookey Kerridge has designed a new apparatus to replace the football bladder. The patient is a man of 63 years. He is suffering from a progressive wasting of the muscles which started in 1927. Although almost completely paralyzed he is still mentally alert and contented. By 1931 he began to have difficulty in breathing as a result of the gradual paralysis of his muscles. From June, 1932, until September, 1933, he was kept alive by manual artificial respiration maintained continuously by relays of relatives and nurses. Then his friend, Sir William Bragg, designed a hand-operated machine for inflating a football bladder bandaged to Mr. Halahan's chest. In October, 1933, he designed hydraulic bellows for inflating the bladder, which worked successfully.

Four Important New Books

The Physical Basis of Things

By JOHN A. ELDRIDGE, Professor of Physics, University of Iowa. *International Series in Physics.* Ready in July

Portrays, for the general student, the physical world as seen by the modern physicist. The book explains, with emphasis on concrete illustrations and with only the simplest mathematics, the meaning of the ideas which, evolving from the older kinetic theory, have culminated in the new atomic theory of today. The author has endeavored to make the book teachable and has included numerous questions, problems, and examples.

Electron Tubes in Industry

By KEITH HENNEY, Associate Editor, *Electronics.* Ready in July

A new book that presents the fundamental principles involved in the use of all the various electron tubes employed in industrial operations; i.e. the amplifier, rectifier, generator, grid-glow and thyratron, cathode ray, voltage and current regulator, etc. The author describes in detail the multifarious applications of the vacuum tube and the photocell, such as motor control, laboratory measurements, power transmission, elevator leveling, counting, sorting, grading, color matching, chemical and mechanical measurement and process control, etc.

Geologic Structures. *New third edition.*

By BAILEY WILLIS, Professor Emeritus of Geology, Stanford University; and ROBIN WILLIS. Ready in June. $4.00

A pioneering text that describes geologic structures and shows the applications of the principles of mechanics to their interpretation. In the new edition speculative discussion of theories has been eliminated, and the arrangement changed to make the book more practical and more logical. The book is fully illustrated by diagrams, sections, and maps.

Earth, Radio and the Stars

By HARLAN TRUE STETSON, Research Associate in Geophysics, Harvard University. *A Whittlesey House Publication.* Ready in June. $3.00

Brings together recent developments in astronomy and its related fields in an effort to suggest a more intimate relationship between man and his cosmic environment. A large part of the book is based on the author's own researches during the past six or seven years towards a synthesis of geology, meteorology, radio engineering and astronomy into a new science—*cosmecology.* A feature of the book is the discussion of sun-spots and radio.

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SCIENCE NEWS

Science Service, Washington, D. C.

DISCOVERY OF SATELLITE-LIKE OBJECT NEAR JUPITER

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THE discovery of what may prove to be the tenth satellite of the planet Jupiter was made at Lick Observatory when Dr. H. M. Jeffers, of the observatory staff, noticed a very faint heavenly object that has the same motion in the sky as the eighth satellite which he was photographing.

Dr. R. G. Aitken, director of Lick Observatory, said that it is by no means certain that the object observed is a new and tenth satellite. He simply announced the photographing of a faint object near Jupiter having daily motions similar to that of satellite eight. Its nature is still uncertain. More photographs are being secured to permit computations to decide whether the object is satellite nine of Jupiter, a new tenth satellite or a minor planet or asteroid of unusual orbit. The new object is very faint and will be observable only in the largest telescopes. It is nineteenth magnitude, which is close to the limit of visibility.

This Jupiter's tenth satellite, if that is what it proves to be, will be one of a trio of extremely remarkable objects in the solar system, the three most recently discovered moons of Jupiter. These outer satellites move around the planet with what is called a retrograde motion, a direction opposite that of the seven inner satellites. The new object is probably only a few miles in diameter and it may be even smaller than the eighth satellite, the diameter of which is estimated at 25 miles.

Jupiter is the fifth planet from the sun and the second outward from the earth. It is the largest in diameter and with ten satellites, it would have the largest number of any of the planets.

USE OF OIL WASTE PRODUCTS

BY a "sweating" heat treatment of petroleum, called pyrolysis, chemists are now using former oil waste products to make a variety of alcohols highly desired by the lacquer, paint and varnish industry as solvents; a soap which cleans and lathers instantly in salty ocean water; a disagreeable smelling substance to go into the natural gas supply of homes and thereby make possible the quick detection of a leak; and synthetic rubber compounds resistant to gasoline and other rubber solvents.

These new by-products are the "cream" skimmed from the raw "milk" of petroleum by the new field of a study of petroleum derivatives, Carleton Ellis, of Montclair, N. J., reported to the twenty-sixth annual meeting of the American Institute of Chemical Engineers.

Chemistry, Mr. Ellis indicated, is attacking the problem of what to do with the many former wastes encountered in the processing of oil for the automotive industry with more than an even chance that a great field of research will be opened, rivaling the hundreds of thousands of dyes and other substances made from coal tar. Coal tar is the sticky, black ooze left behind after coal is heated in containers and coal gas driven off. From coal tar are obtained hundreds of aniline dyes like indigo; medical preparations such as phenol or carbolic acid; artificial flavoring and important chemical base products like anthracene and naphthalene.

The heat-treating of petroleum not only produces many of the important hydrocarbons found in coal tar on which that giant chemical industry is based, but the presence of these hydrocarbons in gasoline, later obtained from the oil, gives the gasoline a high anti-knock value which enhances its value as a motor fuel. The ability of chemistry to obtain many alcohols from petroleum will free grains and natural foodstuffs from the position of contributors to raw industrial sources to their natural position of foods.

"Instead of serving as industrial materials," said Mr. Ellis, "there will be more grain for cattle and cereals, more olive oil for salad dressings and more vegetable oils for other sorts of cooking. At the moment these prospects may not seem important, but in later years their value should have abundant opportunities to become established."

Ethyl alcohol, he added, will eventually excel all the alcohols in only one field and for one purpose—for drinking.

SELENIUM COLLOIDS IN THE TREATMENT OF CANCER

(*Copyright, 1934, by Science Service*)

A NEW treatment for cancer, devised by a British physician, has given relief to some cancer patients whose cases were called "hopeless." It can not be called a cure, since it has not been used long enough to know what the ultimate results will be.

The new treatment reduces pain and discomfort and often enables patients who entered the hospital complete and hopeless invalids to return, for a time at least, to their normal life. It was devised by Dr. A. T. Todd, physician to the Bristol Royal Infirmary, who reported results with it in the current issue of *The British Journal of Surgery*.

Dr. Todd uses a new medicine known as a sulfur-selenium colloid and another colloid of selenium which is combined with radium substances so that it is slightly radioactive. The first medicine is called SSe for short, and the second is abbreviated as R.A.S.

In a large number of instances the patients treated by this method have become apparently well and are still alive more than a year after the beginning of the treatment, which was little used before 1931. Two cases are alive after 2½ and 4 years, respectively.

Dr. Todd first ascertains that all other types of treatment (surgery, x-rays and radium) have failed, that the diagnosis of cancer is certain and that the patient is willing to cooperate by having regular treatment for a period of years if necessary. He then starts by injecting into a vein four cubic centimeters, or about one teaspoon, of SSe. After 48 hours powerful x-rays are trained on the growth.

The doses of SSe followed after 48 hours by x-radiations are given weekly for eight to fourteen weeks. When the position of the cancer is such as to make the patient highly sensitive to treatment the dose is cut in half. By spreading the dosage of x-rays over a longer period than the normal eight weeks, when necessary, care is taken to avoid too marked a reaction.

After this preliminary course, in which the selenium is gradually "ionized," that is, changed in its electrical properties by the x-rays, the regular treatment is begun. For the first three weeks doses of R.A.S. are given at weekly intervals; thenceforward the doses of R.A.S. are given alternately with SSe, each every two weeks. The R.A.S. is believed to act in the same way as the x-rays, though on a much smaller scale, in ionizing the selenium colloid.

Dr. Todd believes this ionization to be an important part of the treatment, which is considered to act as a stimulant to the body's defensive mechanism against cancer, and not to have any direct effect on the growth. He has developed an ingenious theory as to the nature of this mechanism, and considers that cancer is an infective disease.

If the patient's condition appears to improve, the alternate injections of the two colloids are continued regularly and are stopped only when the cancer symptoms have disappeared. But when the treatment is unsuccessful the "preliminary" combination of SSe with x-rays is repeated after a three-month interval.

Insufficient time has elapsed to show whether this new method may sometime provide a complete cure for cancers otherwise incurable.

POST-MORTEM BLOOD FOR TRANSFUSION

BLOOD from the dead is now saving the lives of many patients who would otherwise bleed to death. Professor Serge Judine, chief of the surgical service of the Institute Sklifassovsky, the great emergency hospital of Moscow, has reported more than a hundred such transfusions without ill result.

Dying victims of traffic accidents and other emergencies are brought into this hospital in such numbers that the supply of blood from living donors is not enough to save them. At the same time, the ambulances bring to the institute many victims of accidents, violence and heart attacks who have only just succumbed. Professor Judine conceived the idea of using the blood from these dead bodies to save the living.

Careful studies showed that the blood remained alive and sterile, that is, germ-free, for eight hours after death. Tests to determine the group it belongs to and tests for syphilitic infection can be made up to four hours after death.

The first application of Professor Judine's idea on a human case was made on a young engineer who had attempted suicide by cutting the veins in his elbow. The patient was almost dead from hemorrhage when brought to the hospital. Professor Judine had on hand the body of a man who had died six hours before of a heart attack and whose blood was the same type as that of the young engineer. He gave the would-be suicide a transfusion of about a pint of blood drawn from the veins of the dead man. The usual remarkable response to blood transfusion occurred and the patient quickly recovered without any unfavorable reaction.

Blood is now regularly collected for such use. It is taken from the jugular vein and stored in large jars containing sodium citrate solution to keep it from clotting. Tests for blood group and for syphilis are made and it is then stored in a refrigerator at nearly freezing temperature. After two weeks of such storage it is still sterile and living and the red cells are able to perform their mission of carrying oxygen. When needed it is heated to a little more than body temperature and strained through several layers of gauze as a precaution against small clots that may have formed.

MIGRATION AND SUPERIORITY

NATIVE American farmers in the eastern United States are surprisingly incompetent in comparison with their immigrant neighbors when their inherited opportunities are taken into account, according to a statement made by Dr. Ellsworth Huntington, of Yale University, at the annual meeting of the Population Association of America. The laws of migration are of the utmost importance historically, economically, politically and socially, although they are little understood.

"The first law, as to the selective quality of migration," he explained, "is illustrated by the way in which the long distance migrants, no matter where they were born, or where they now live, rank consistently above the non-migrants and the short distance migrants. The second law, as to the attractive power of opportunities, finds its illustration in the fact that the cultural rank of the people here considered rises in harmony with the size not only of their birth-places, but of their places of residence. The third law, as to the correlation between the length or difficulty of the migration and the quality of the migrants, receives confirmation in the systematic way in which the long-distance migrants stand above the others except perhaps in the great cities and their suburbs. According to the fourth law the farther people migrate the more those of different origin become alike.

"They have a direct bearing not only upon immigration policy, but upon such every-day problems as the value of real estate, the advisability of starting industries and methods of preventing crime. Scarcely any major phase of modern life is free from complications due to the selective action of migration.

"Other things being equal, the longer, or more difficult a migration, the more closely do people from all sorts of sources resemble one another at the end. This suggests that the relatively weak elements in a population are in some ways its most characteristic portion. The farmers of China, Russia, Germany and America differ from one another in their ways of working, living and thinking much more than do the most highly educated and cosmopolitan members of these various nations. Men like Tolstoi, Tagore, Einstein and Woodrow Wilson have far more in common and far more sympathy for one another than do ignorant laborers from the same countries. It seems to follow from this that if in the course of centuries new nations could be built up from the finer elements of the present nations, their differences

would be much less than those which now divide one part of the world from another.

"Applied to the United States and its relation to foreign countries the laws of selective migration lead to certain conclusions at which many people may balk. For example, although most people agree that urban populations are more competent than those of rural districts, many will violently assail the idea that the average quality of the American people improves from east to west and is highest on the Pacific coast. Perhaps they are right, for any just conclusion must take note of all the laws of migration.

"One of the laws suggests that although the average migrant from the eastern to the western states outranks the average person who is left behind, the number of westward migrants belonging to the most highly competent sections of the population has been proportionally much lower than among those of less ability. Moreover, the wealth and opportunities of the East attracts many westerners of high ability, whereas those of lower ability do not show so much tendency to migrate back to the East.

"This means that as a result of migration the East tends to be characterized by a high percentage of unusually able people and a correspondingly high percentage of people of less than the average ability. In the far West, on the other hand, the tendency seems to be toward a population with relatively lower percentages of the highest types of leadership and the lowest type of incompetence, but with a very large and substantial middle class.

"The average level of this middle class is so high that we may well expect that in time it will produce many leaders of unusual ability. Judging from older lands it also seems reasonable soon to expect from the West great contributions to human progress and betterment. Already such contributions are beginning in the fields like astronomy, and we may look for them also along lines of economic, political and social betterment."

ITEMS

MEASLES has broken a twenty-one-year record. The number of cases reported each week has been higher than at any time since the U. S. Public Health Service began keeping records of this disease in 1912. The epidemic has just begun to abate, less than 30,000 cases being reported weekly now. At the peak of the epidemic, during the first week in April, 35,000 cases were reported by state health officials to the U. S. Public Health Service.

A NEW method for increasing the vitamin D content of evaporated milk on a commercial scale has been developed by K. G. Weckel and H. C. Jackson, of the University of Wisconsin. The usual commercial methods of manufacturing evaporated milk are followed prior to and after irradiation. The new process includes the use of a specially devised machine which permits the hot evaporated milk to flow in a thin film over an inner corrugated surface while it is being exposed to the ultra-violet rays produced by a carbon arc lamp. After irradiation, the milk is homogenized at the usual pressures, is cooled, canned and sterilized in the normal way. Mr. Weckel and Mr. Jackson also found that cream can be irradiated without losing its natural and desirable flavors, which was formerly doubted. The irradiated cream is then recombined with the rest of the milk and handled in the customary commercial way. Both processes are now commercially possible and evaporated milk companies are producing such milk under license. When this new irradiated evaporated milk is diluted with an equal part of water it has the same amount of rickets-preventing vitamin D per quart, which is 50 Steenbock units or about four to five times that of normal milk, as is required for the ordinary irradiated whole milk now on the market.

A TEN-MINUTE test with a mouse will show whether or not a horse has been treated with morphine or heroin before a race, according to a report made by Dr. James C. Munch, of Temple University and the Sharp and Dohme Research Laboratories, to the American Pharmaceutical Association. A quarter of a teaspoonful of the horse's saliva is injected into the mouse. Within ten minutes, if the horse has been given morphine or heroin, the mouse's tail curves up into the shape of the letter S. In addition, the mouse humps up his back, his hair stands on end and his hind legs become twittery. Chemical tests for morphine in the saliva take two days and are less sensitive than the mouse test, which shows the presence of as little as one seventy-five-thousandth of a grain of morphine.

BOYS and girls start their adolescent spurt of growing when they have reached a certain height rather than at a certain age. This finding was reported by Dr. Carroll E. Palmer, of the U. S. Public Health Service and the Johns Hopkins School of Hygiene and Public Health, at the meeting of the American Association of Anatomists. Dr. Palmer analyzed annual measurements made during a period of four to seven years on about 2,500 elementary school children between the ages of 6 and 14 years. The adolescent acceleration of growth begins, apparently independent of age, when girls and boys reach an average height of 50 and 53 inches, respectively, he found. From the age of six years to the start of this adolescent growing spurt there is practically no association between the average gain in height and that height already attained by the child.

A DIMINUTIVE dinosaur was described before a meeting of the Paleontological Society by Professor Charles L. Camp and Dr. V. L. VanderHoof, of the University of California. The remains of this small saurian, which ran about on its hind legs, like a bird, were found in northern Arizona by members of a party under the leadership of Dr. Ansel Hall, of the U. S. National Park Service. Other papers at the session of the Paleontological Society disclosed a record of much activity and many discoveries of interesting and important fossil records in the West. They included new links in the line of descent of horses, an extinct rabbit-like animal, the skull of a gigantic extinct bison, and a possible ancestor of the beautiful but zoologically puzzling modern pronghorn antelope.

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SCIENCE NEWS

Science Service, Washington, D. C.

PREVIEWS INTO THE FUTURE OF SCIENCE

PEERING into the next century, industrialists and scientists have attempted to predict the forthcoming accomplishments of pure and applied science.

These forecasts were made in connection with the "Jules Verne" survey of industrial progress in the next century arranged by General Motors Corporation simultaneously with the opening of the second summer of the Century of Progress exposition in Chicago.

Among the previews obtained were:

FUTURE OF MAN

"The average life of mankind in the time of Queen Elizabeth was twenty years. To-day the average is fifty-eight years for man and sixty-one for woman, who is biologically more important. . . . Recent discoveries in medicine are leading to astonishing results, and give a prospect that the life of man will soon reach the Biblical promise of three score and ten."—Drs. W. J. and C. H. Mayo, of Mayo Clinic, Rochester, Minn.

"We are on the threshold of advances in biology generally, and particularly human biology, that will fundamentally alter our outlook. . . . Already we know how in the laboratory to increase the power of lower organisms to utilize their available resources in food material and energy for vital processes, such as growth and duration of life from three to ten times over their usual performance with corresponding relative increases in size, longevity, and so forth. . . . Developments and applications along these lines are likely to come in the not too distant future."—Dr. Raymond Pearl, The Johns Hopkins University.

"Biologically speaking it is fair to say that man's social progress is now only at its beginning and that the two million years that separate us from the cave-man mark only the start of human life. The progress of the next two million years is as inevitable as that of the last, and when we have reached this new goal such events as the present depression will have vanished beyond recognition."—Dr. G. H. Parker, president, American Academy of Arts and Sciences.

"The next century should see an extension in the conquest of science over the forces of nature so astounding that imagination is inadequate to conceive of the final result. In the field of organic chemistry our knowledge of the vital chemical processes of living matter will be so enormously increased that it is not too much to say that the life cycle itself may be controlled to the end that old age shall have disappeared and that many then alive may live to ages rivalling that of Methuselah."—Thomas Midgley, Jr., vice-president, Ethyl Gasoline Corporation.

FUTURE OF RESEARCH

"The material world is so infinite in its variety that I am convinced modern science, modern inventions and modern methods of mass production have only scratched the surface. The inventions which we have seen so far are only a foretaste of what is to come, provided only the spirit of man is pointed in the right direction and we are able to experiment in the field of social science in as scientific and good-natured a way as we experiment in the field of physical science."—H. A. Wallace, Secretary of Agriculture.

"Scientific invention must continue but social invention must provide an efficient distribution of wealth to supply buying power adequate to the flow of mass production."—Charles A. Beard, Author.

"Available work can be continually expanded and progressively higher standards of living made possible through developments of science and industrial research. At the same time in my opinion if the utmost is to be achieved there must be equal development of social consciousness on the part of leaders in science and industry. Planning on a national scale with a view to making this a land of comfortable, efficient, attractive homes would seem to be indicated with every industry cooperating in that definite purpose rather than each working independently and sometimes at cross purposes."—Lowell Mellett, editor, Washington, D. C., *Daily News*.

"It is of the utmost importance to society that research in pure and applied science be speeded up to improve the methods of industry and its products and to create new processes or products that man will desire to possess and which therefore may create new industries."—C. R. Richards, president, Lehigh University.

"We believe America's inventiveness is little more than started. With seventeen hundred industrial research laboratories in operation compared with two hundred twenty years ago, no other conclusion is justified."—C. M. Chester, president, General Foods Corporation.

FUTURE OF MATERIALS

"The more systematic application of the scientific method to the art of steel making and the development of more fundamental knowledge of the wonderful properties inherent in iron and its alloys is going to lead to a picture and a control of the molecular architecture of steels which will enable the user to choose that steel which is really best for his particular purpose, to improved steels of many kinds, to steels which will better satisfy the insistent demands of many diverse industries for a metal which will be satisfactory under continually severer conditions of service. This will result in the lightening, indeed in the redesign, of many structures and machines with economic advantages so great as to bring about a large amount of reconstruction."—John Johnston, director of research, U. S. Steel Corporation.

"Rail tires of no less than three types are ready for a coming market. An astonishing new safety device for automobiles is in the making. The major line of balloon tires has undergone a radical change resulting in much longer non-skid life."—B. Darrow, development manager, Goodyear Tire and Rubber Company.

"Rapid progress in the methods of manufacture, of improvement of quality and of methods of fabrication of sheet metal is making tremendous contributions to human welfare. Sheets for forming operations are offering homes of greater comfort and at greatly reduced cost. The application of sheet metal for pressed steel porcelain sanitary ware, such as sinks and wash basins, is making sanitary facilities of beauty available at only a fraction of former costs. The development of refrigeration and air conditioning is making healthful conditions of living available to a greater percentage of the people."—Dr. Anson Hayes, director of Research Laboratories, American Rolling Mill Company.

"Carpet making from all modern raw materials filling carefully analyzed functional requirements will replace traditional textile materials fabricated in imitation of old world craftsmanship. Rubber pyroxylin and resins are already accepted as logical carpet materials, in addition to conventional hair and vegetable fibers. Carpets will be utilized not only for adornment but because of acoustical and thermal properties as well."—G. E. Hopkins, technical director, Bigelow Sanford Carpet Company.

"Incandescent lamps of improved design resulting in higher electrical efficiencies promise savings in current consumption. Ultra-violet lamps and sources of the lower wave-length radiation offer new possibilities to this general field. Further, the development of the new gaseous vapor discharge lamps, including the sodium lamp and the high pressure mercury lamp, promise new offerings in electrical efficiency and the character of lighting."—A. M. Hageman, manager research staff, Westinghouse Lamp Company.

"We are just beginning to enter the age of alloys and much more is to be expected in improved physical properties and resistance to destruction by corrosion. Welding precipitation, hardening, also heat treatment and methods of manipulation are only beginning to be understood. New materials are promised for commercial use."—William H. Bassett, research staff, American Brass Company.

"Science has shown us how to duplicate almost all the important petroleum products by chemical treatment of the almost inexhaustible supplies of shale and coal. While such processes are not economically feasible in this country at present, they certainly will become so long before our oil reserves are fully exhausted, so that a civilization based so largely on oil heat and oil power need have no fear for its basic supplies."—E. G. Seubert, president, Standard Oil Company of Indiana.

"The greatest future development in the oxy-acetylene industry will probably be in flame machining. Applying an oxy-acetylene torch to a steel cylinder, it is possible to make a cut corresponding to a machine tool cut ½" deep with a 2" feed at a peripheral speed of 10 ft./min. and the power required for the rotation of the steel being cut may be a fractional horsepower motor."—John J. Crowe, engineer, Air Reduction Sales Company.

"I can visualize the products of the orchard and field of Turkestan or California served in London ten years thence with all the native freshness and taste of those freshly gathered. This means suspended animation of both enzymes and organized microorganisms. Not less interesting and romantic will be the container for these foods which I visualize as nonmetallic, transparent and nonbreakable."—Charles S. Ash, director of research, California Packing Corporation.

"Strong aluminum alloys will permit construction of more and better bridges for the taxpayer's dollar and further aluminization of automobile engines would improve efficiency and comfort in motoring."—F. C. Frary, research staff, Aluminum Company of America.

"More than any other human activity, our country's metallurgical, chemical, physical and social laboratories will enable us to satisfy those needs not yet realized and will continue to create more and better jobs by improving our transportation, housing and recreational facilities."—W. B. Lashar, Jr., director of research, American Chain Company.

"No science has progressed faster than chemistry and the one inexhaustible source of chemical raw material is the farm. More and more the chemist is showing the way toward increased markets for agricultural products. This was unknown fifteen years ago. To-day in a small way it is being done. To-morrow it should be a reality."—F. N. Peters, director furfural laboratory, Quaker Oats Company.

"Progress in cellulose chemistry is just beginning to strike its stride. The rayon, cellulose and film industries are only a beginning of new industries based upon cellulose as a raw material. Pulp and paper will continue to become more and more important in this next century of advanced civilization."—Bjarne Johnson, director research staff, Hammerhill Paper Company.

"In the future, metal will be removed from hard materials by new types of abrasive wheels and new methods at rates comparable with the rate at which stock is removed from softer metals by milling machines to-day. The grinding of pulp by artificial abrasives will be so controlled that use of chemical processes will not be necessary to produce strong paper. New, harder and tougher cutting materials will revolutionize the grinding industry and invade the field held by cutting tools, such as carboloy and stellite. Smoothness and accuracy of finish is advancing rapidly, with consequent decrease in the wear of moving parts. The life, efficiency and range of action of synthetic resin bonded abrasives will be almost indefinitely increased due to application of new resins and methods of manufacturing."—R. C. Benner, director research and patent staff, Carborundum Company.

"Ophthalmic optical development to improve the vision of mankind has by no means reached its end. New optical glasses will be developed in the future which will give optical designers a chance to improve existing optical instruments."—Carl L. Bausch, manager research and engineering, Bausch and Lomb Optical Company.

"Recent developments in rubber which will undoubtedly expand are the manufacture of elastic fabrics, the application of rubber to automobile and other mechanical engineering problems to absorb vibration, the protection of chemical engineering materials against corrosion and

many others.''—W. A. Gibbons, director of development, U. S. Rubber Company.

FUTURE OF TRANSPORT

''Tires of the future will be larger, softer and safer, running on immeasurably less air pressure.''—W. O'Neil, president, General Tire and Rubber Company.

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''Road-building costs will be so reduced by scientific improvements in Diesel track type tractors and allied equipment that all the inaccessible parts of our country will have the blessing and comfort of perfect highways for automotive transportation. The building of dams and levees, the digging of irrigation canals and ditches will be done so easily and cheaply that no one need farm stony, barren and unproductive soil, but will have available the fine fertile unused lands of this country that require only water and tillage to produce the crops that will be needed by highly paid skilled workmen.''—Oscar L. Starr, vice-president in charge of research division, Caterpillar Tractor Company.

''Decentralization is undoubtedly the requisite for higher standards of living and a concomitant to decentralization is better transportation.''—W. C. Hamilton, research director, American Steel Foundries.

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''It is not unreasonable to expect the future to give us any desired comfort in the home at a cost within the reach of the majority and any desired food regardless of location or season of the year.''—Wm. R. Hainsworth, director of engineering, Servel, Inc.

''Through the development of new and better devices in transportation, air conditioning, industrial processes, home applications and improvements in public health, we can expect in the next few years great improvements, the creation of new industries and new jobs through the commercialization of new scientific knowledge, which is now being obtained faster than ever before.''—L. W. Chubb, director research laboratories, Westinghouse Electric and Manufacturing Company.

FUTURE OF COMMUNICATION

''Lithography and printing can now be appreciated only through the medium of vision. With certain modifications they can conceivably be made to appeal to the auditory sense as well.''—Robert F. Reed, department of lithographic research, University of Cincinnati.

''New avenues of approach to the use of ultra short waves have recently been opened. Multiplex transmission sending three different radiograms simultaneously on the same wave-length will be utilized in the new domestic radio telegraph service of RCA. High speed radio facsimile gives promise of a new method of reproducing messages in their original form instead of by coded dots and dashes.''—David Sarnoff, president, Radio Corporation of America.

''New developments will give us pictures in real color, stereoscopic in character, and with sound practically as faithful as the original.''—E. H. Hansen, director of sound recording, Fox Film Corporation.

ITEMS

A VERITABLE porcupine of the sea, a giant sea urchin with spines a foot long, has been given scientific description for the first time by Austin H. Clark, curator of echinoderms at the U. S. National Museum. The creature is believed to be the biggest sea urchin known from any part of the Atlantic Ocean. The giant sea urchin was discovered by Dr. P. Powers, of the Carnegie Institution of Washington, in the shallow waters around the Dry Tortugas Islands. Its round body is about six inches in diameter. It is covered with hundreds of foot-long, barbed black spines. Among their bases are about 200 bright blue eye-spots arranged in rows. These appear to be true sight organs, for when anything moves in front of them the long spines are kept pointed menacingly at it.

PEOPLE susceptible to hay fever who owe their suffering to the ragweed pollens should keep away from insecticides made from pyrethrum, according to Dr. Samuel M. Feinberg, speaking before the American Medical Association at Chicago. Among the common household insecticides of this kind he mentioned Black Flag and Flit. Out of 225 persons who start sneezing when the late summer breezes blow ragweed pollen about, skin tests showed that 104 were sensitive to commercial pyrethrum. Insect powders and sprays containing pyrethrum may bring on attacks of hay fever in these persons outside the ragweed season.

New McGraw-Hill Books

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Presents in logical sequence the principles of plant taxonomy and nomenclature and discusses representative families of plants. The book has been completely revised; much of the material has been entirely rewritten; and the organization has been improved. A number of new, original illustrations have been added.

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By EDWARD ARTHUR FATH, Professor of Astronomy in Carleton College. *McGraw-Hill Astronomical Series.* 360 pages, 6 x 9, $3.00.

This well-known elementary guide to astronomy has for eight years held a unique position in the field as a thorough, non-technical presentation of the facts of astronomy and the principles and methods used in modern astronomical investigations. As before, the treatment is largely non-mathematical, and the general plan, which proved so successful in previous editions, has been retained. The later chapters have been in part rewritten, and all material has been revised in the light of recent developments.

Kinetic Theory of Gases

New second edition

By LEONARD B. LOEB, Professor of Physics, University of California. 678 pages, 6 x 9, $6.00.

This well-known text develops the classical ideas of the kinetic theory in a simple, accessible manner, combining them with the recent experimental and theoretical advances in the subject. A third of the book has been completely rewritten. The classical treatment remains essentially the same, but the sections dealing with the more recent developments have been revised and brought up to date, especially the chapters on specific heats, the equation of state, the distribution law, etc.

Earth, Radio and the Stars

By HARLAN TRUE STETSON, Research Associate in Geophysics, Harvard University. *A Whittlesey House Publication.* 336 pages, 5½ x 8, $3.00.

Brings together recent developments in astronomy and its related fields in an effort to suggest a more intimate relationship between man and his cosmic environment. A large part of the book is based on the author's own researches during the past six or seven years towards a synthesis of geology, meteorology, radio engineering and astronomy into a new science—*cosmecology.*

Principles of Animal Biology

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By A. FRANKLIN SHULL, Professor of Zoölogy, University of Michigan. With the collaboration of GEORGE R. LARUE and ALEXANDER G. RUTHVEN, University of Michigan. *McGraw-Hill Publications in the Zoölogical Sciences.* 400 pages, 6 x 9, $3.50.

The basic aim of this standard text, representative of the so-called "principles" course, is to present a body of principles which may be brought under such topics as morphology, physiology, ecology, taxonomy, geographical distribution, paleontology, and evolution. The present revision is by far the most extensive that the book has yet received, and covers all recent investigations and changing emphases in various branches of the subject.

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As before, this carefully organized series of laboratory directions stresses the important generalizations of biology. Shifting values dictated by laboratory experience, modification of terminology in accord with prevailing practice, the need for more specific indication of principles illustrated, the discovery of additional or better material for study in some of the exercises have contributed to the necessity for revision.

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW DEVELOPMENTS IN AERONAUTICS

STILL greater airplane speeds and added safety and economy for private, transport and military planes are foreseen as the result of research conducted during the past year by the National Advisory Committee for Aeronautics.

In the past four years as a direct result of NACA research applied by manufacturers, airplanes have had their speeds boosted by 75 miles per hour with no increased power required. Now airplane designers and manufacturers making their annual visit to the NACA laboratories at Langley Field learned of new researches that seem likely to give another spurt to improved airplane design.

Some of the possibilities are: New methods of lateral control, replacing ailerons standard for twenty-five years, will greatly accelerate the use of airplanes by private pilots. The most promising are flaps called spoilers that when raised lengthwise above the wings by the pulling of a lever will allow shorter take-offs and shorter, safer landings by relatively unskilled flyers.

Through the simple device of making one seemingly insignificant part of a seaplane float pointed instead of square, flying boats carrying fifty passengers across the Atlantic are foreseen. The new float proved its worth in the NACA world's largest towing basin at Langley Field.

Autogiros are capable of flying two hundred miles per hour, wind tunnel tests show, whereas last year it was generally agreed that this "vertical windmill" type of aircraft, radically different from the airplane, would be useful only for slow speeds.

The speed of airplanes, already increased 75 miles an hour by NACA research upon better engine location and reduced air resistance of engines, will soon be increased another 50 miles per hour. This is promised by refined design of the way wings and fuselage are arranged. This means that transports cruising at 250 instead of 200 miles per hour will be possible in the next few years.

Air sucked in at the tops of airplane wings through slots will probably be used to increase the lifting power of the wings at low speeds without increasing air resistance. The effectiveness of putting suction fans into the wings was demonstrated by NACA engineers who flowed streams of smoke around a model. Use of a few per cent. of the power of the engine in this way will allow the control of the thin "boundary layer" of air over the top surface of the airplane's wing, and increase the lifting power 150 per cent. This will greatly aid in the take-off and the landing, allowing planes to get off the ground more quickly with heavier loads, and then get down safely over high obstructions into smaller landing fields.

More power from aeronautical engines without increased size and probably reduced fuel consumption is a future development. This will come through the use of forced air cooling by blowers, injection directly to the cylinders of safety fuel that will not detonate violently or "knock," and use of two-cycle engines. It was predicted that the next big advance in aviation would be in engine improvement.

Fuel economy is foreseen as a result of a NACA spark-ignition test engine in which safety fuel is injected directly into the combustion cylinder. In ordinary engines, gasoline is mixed with air in a carburetor. This new engine, when cooled by forced air draft, runs on only about four tenths (0.41) of a pound of fuel per horsepower hour compared with five or six tenths of a pound in the case of typical gasoline aviation engines now used. This approaches the fuel economy of the diesel engine (about .36 pound per horsepower hour) and NACA engineers consider it possible that a new safety fuel injection engine can be developed that will make unnecessary the further development of diesel aviation engines.

Violent vibration of airplane parts, called "flutter," has been explained mathematically by Dr. T. Theodorsen, of the NACA staff. Sometimes flutter has wrenched airplanes to pieces in midair, destroying their wings or tail surfaces. Now designers using Dr. Theodorsen's formulae can be sure that flutter will not occur in any airplane part that they intend to build.

The National Advisory Committee for Aeronautics is an independent agency of the federal government charged with undertaking research for the air of all aeronautical activities, military and commercial. Present at the recent meeting were Orville Wright and Colonel Charles A. Lindbergh, who are among the members of the committee. Dr. Joseph S. Ames, president of the Johns Hopkins University, is chairman, and Dr. G. W. Lewis is director of research.

THE SKULLS OF LIVING AND FOSSIL ANIMALS

"THEY never come back."—The old axiom of the sporting world applies to bones in evolving lines of animals as well. There has been, throughout the long history of vertebrate animal development, a steady tendency for the bones of the skull to become fewer and more specialized. The lessening in number of bones has been accomplished partly through sheer disappearance, partly through the fusion into one bone of two or more originally separate bone units.

At a joint meeting of the American Society of Mammalogists and the American Association of Physical Anthropologists, Professor William K. Gregory, of the American Museum of Natural History, presented the results of an extensive study on the skulls of living and fossil animals, conducted jointly with Miss Marcelle Roigneau and a number of graduate students.

The basis of the dictum supported by the researches of Professor Gregory and his associates is what he calls "Williston's Law," a generalization that originated with the late Professor S. W. Williston, of the University

The World List of SCIENTIFIC PERIODICALS

The Second Edition of The World List of Scientific Periodicals will be published on June 30, 1934, by the Oxford University Press, London, at the price of Three Guineas. Subscribers in advance will receive it at Two Guineas. Subscriptions should be sent to The Secretary, The World List, C/o The Zoological Society, Regent's Park, London, N.W.8.

The Second Edition, complete to the end of 1933, contains the full titles of approximately 36,380 publications publishing the results of scientific research, standard abbreviations of the titles and indications of over 183 Libraries in which the periodicals are filed.

The issue of the Second Edition has been made possible by a grant from the Royal Society of London and by the voluntary efforts of many persons. The control and ownership of The World List are in the hands of a Corporation under the Companies Acts 1908–1917, and any profits will be kept towards the cost of future Supplements or Editions.

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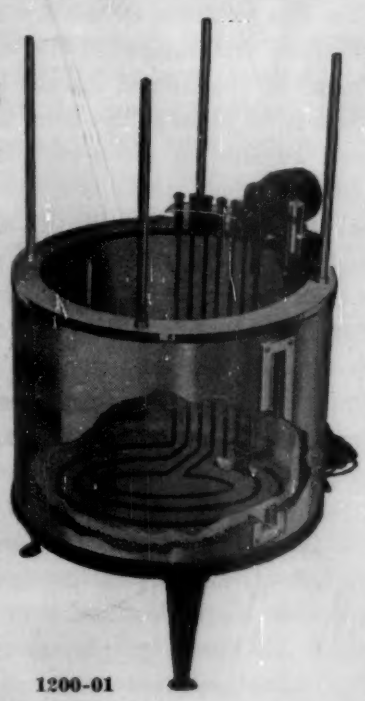

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of Chicago. Professor Williston noted the much larger number of bones in the skulls of certain ancient reptiles, as compared with their modern successors and with the mammals, including man. Professor Gregory has further extended Professor Williston's generalization and tested its truth for the whole vertebrate animal group.

Among fishes, he found that the most primitive have as many as 180 skull bones, while higher forms have only about 100. The lowest members of the amphibia, or frog-toad-salamander group, had 90 to 95 bones in the skull; the higher modern ones, only 50. The earliest reptiles had skulls in some 80 pieces, while the most highly evolved modern ones, the snakes, possess 50-bone skulls.

The very strange reptiles that apparently started the mammalian line of development had something over 70 skull bones; the most primitive of mammals, the marsupials, have less than half that number; primates, which include monkeys and men, have about 30.

Primates are usually considered to be the highest of animals, and in most respects the claim is probably correct. But there are a few highly specialized animals outside this lordly group of ourselves and our next of kin that beat us at the skull-bone reduction game. Peccaries, which are little pig-like animals that live from Texas on southward into the American tropics, have their skulls so fused that they may be said to have only two bones apiece: the lower jaw, and the rest of the skull.

THE PLACEMENT OF MORONS

MORONS, poor weak-witted jetsam of our hit-or-miss human breeding, have a useful place in the world. And the common sense of peasant-stock immigrants can find that place better than most of our fine-spun social theories. So Dr. Charles Bernstein, of the State School for Mental Defectives at Rome, N. Y., indicated in an address before the meeting of the American Association for the Study of Mental Deficiency. According to Dr. Bernstein, "The second generation of foreign-born will show us what to do with our morons."

The foreign-born in our population, particularly the Poles and Italians, know what to do with morons, Dr. Bernstein continued. They put the sixteen-year-old girls of subnormal intelligence to work in their homes, doing housework and watching younger children. They put the boys of this class to work in the fields. The moron of the future will be our common laborer as he has been in the past. But he will be more stable.

The problem of delinquency among morons can be very largely solved by handling the morons as the Poles and Italians in this country do, Dr. Berstein seems to think. The biggest task now is to create the proper environment for them after they leave the state schools for mental defectives.

Stable morons who give no trouble come from stable, orderly homes. Nine tenths of the morons are in this class. The other tenth, which is made up of the group of delinquent mental defectives, comes from disorganized homes. The state must do something for this group. If they are returned to their disorganized homes after leaving the state schools their training in routine, orderly living will be undone and they will return to their delinquent ways.

For this group, particularly, Dr. Bernstein recommends way-stations of the sort established by the Rome State School over twenty years ago. When these children are released from the school they are placed in special homes, twenty of them living together under the supervision of a stable married couple. The boys are put to work on farms and the girls help with housework or in the country-town mills, when they can be given jobs without displacing other workers. Before the depression this was easy to do because the morons would work for low wages which the mentally normal boys and girls scorned.

These young people spend three years at the colony-home and are discharged at the age of seventeen, able to live an independent, orderly life. Out of 2,500 cared for in this way, less than one tenth failed to adjust themselves adequately when they left the colony.

THE TREATMENT OF SCHIZOPHRENIA

Two new and potent reducing medicines may prove to be the means of bringing certain mental disease patients back from their dream world to the real world of sanity. This possibility is indicated by a report by Drs. J. M. Looney and Roy G. Hoskins, of Boston, presented before the American Psychiatric Association in New York.

The medicines have the long chemical names of dinitrophenol and dinitro-ortho-cresol. They cause patients to lose weight by making their body fires burn faster, using excess body fat as fuel and burning it off. The process requires the patients to use up more oxygen, and it is this feature that suggested the use of the drugs for the treatment of the mental disease known as schizophrenia.

This mental ailment has been called a dream state, the patients resembling sleep-walkers who do not awaken. Not only are their minds in a dream state but the physiological processes of their bodies are slowed up, somewhat as they are slowed up in normal persons during sleep.

Dr. Hoskins had found previously, among other things, that such patients use less oxygen during their waking hours than do normal persons. Whether this decreased consumption of oxygen is a cause of the disease is not known; but it is significant that when normal persons are deprived of oxygen, they develop certain symptoms seen in schizophrenia. These symptoms include defective judgment, slowness of perception, inattentiveness, silly laughter, anger without adequate cause, destructiveness, mental confusion and even hallucinations and delusions. All these symptoms, characteristic of schizophrenia, have appeared in normal persons whose oxygen consumption was reduced.

Following this lead, Drs. Looney and Hoskins gave the new reducing medicines to ten schizophrenic patients. Two of them improved during the treatment, but not enough time has elapsed to show whether the improvement will be lasting and actually due to the influence of the drugs. However, since no significant harmful effects have been observed, the Boston investigators feel

justified in continuing the treatment long enough to determine its worth.

The fact that no harmful results followed the treatment with these medicines is important, because they are so powerful that if they are not given in proper doses they may produce serious results. Deaths have followed their use by persons who took them without a physician's guidance.

One of the medicines, dinitro-ortho-cresol, turned the patients' skins yellow after a time, but there was no evidence of damage to the liver, and the yellow color disappeared two days after the medicine was stopped. This skin discoloration may prove a practical danger signal in the use of this drug.

ITEMS

THE complex overtones that distinguish various musical instruments and human voices are broken up into a "sound spectrum" by a new instrument demonstrated at the annual convention of the Institute of Radio Engineers in Philadelphia. This device performs the analysis of sound in about a tenth of a second, which with previous methods required hours of tedious work. The various frequencies of the sound are projected visually, spread out on a screen, just as a prism spreads light rays into the rainbow-like spectrum of light. The new device, which has received the convenience-name of "sound prism," was developed by Professor Knox McIlwain and O. H. Shuck, of the University of Pennsylvania. It is expected to be of great assistance to radio engineers, in determining how far apart in wave-lengths it is necessary to separate broadcasting stations to secure the natural transmission of sounds produced by various musical instruments. The necessary wave-length separation of radio stations for the natural transmission of sounds was discussed at the meeting of the National Association of Broadcasters. This may become a problem of great importance, since if it is necessary to provide a wide wave-length separation of stations, the broadcast band will be too small to accommodate all those now in existence.

DR. BALTH VAN DER POL, director of the Phillips Radio Works in Eindhoven, Holland, stated before a meeting of the Institute of Radio Engineers that radio tuning which separates stations according to their wave-lengths may not be sufficient to prevent interference if the power of broadcasting transmitters is sufficiently increased. He reported that interference has been noted in Holland between two distant high-power European broadcasting stations separated in wave-length by over 800 meters. If these conditions appear as the power of American broadcasting stations is increased, the Federal Radio Commission may have new problems to consider. Dr. van del Pol, who directs one of the largest radio research organizations in Europe, attributes the observed interference to an interaction or cross-modulation of the two high-power signals in the region of the upper atmosphere called the Kennelly-Heaviside layer.

THE Japanese, according to a report of the Radio Research Committee of Japan's National Research Council, seem to be in possession of a secret which enables wireless stations to transmit the human voice in a way that is entirely incomprehensible to the average listener-in. Dr. Shigetaro Chiba, of the research laboratory of the Tokyo Electric Company, says that his method is superior to other methods of secret telephony because of its simplicity and the good quality of speech when it is demodulated at the receiving end. The set he uses is equipped with a microphone constructed so that the speech current is inverted with respect to frequency, making it unintelligible. At the receiving end the same sort of equipment is used, which demodulates the speech by inverting it back to normal. Any one else listening in, however, hears a queer jumble which it is impossible to translate.

SERIOUS and sometimes fatal accidents which come as a result of a broken airplane propeller may now in a large part be prevented as the result of a careful study of vibrations. Almost all propeller failures come as a result of "fatigue," that is, cracks and fissures are slowly formed in the blades under conditions of excessive vibration. Eventually, if the blade is not repaired or replaced a break occurs, which means a forced landing. Drs. Hugh L. Dryden and L. B. Tuckerman, of the National Bureau of Standards, have been making a study of the causes of failures at the request of the Department of Commerce. They have devised an instrument which operates on the general principle of a Baldwin telephone receiver. It is placed on the propeller shaft and records electrically the amount of vibration in the propeller at any speed. Thus the critical speeds, those at which the vibration is the greatest, can be avoided by adjusting the throttle.

SOLID carbon dioxide, popularly named "dry ice," may, at a temperature of 112 degrees below zero Fahrenheit, compete with heat in securing "shrink fits" for machine parts. W. H. Swanger, of the National Bureau of Standards, who has been conducting experiments with solid carbon dioxide reports that machine shop practise may come to accept the new method of applying excessive cold instead of heat in shrinking metals. When it is necessary to secure a metal band to a shaft, the usual practise is to heat the band. Expansion allows it to be slipped into place, and as it cools it contracts to a tight fit. However, by "refrigerating" the inside part, or shaft, it can be shrunk materially. The band is slipped on and when the shaft warms to room temperature it expands again to normal size, and a tighter fit is secured.

EXPERIMENTS throwing light upon the effect of the emotions on the heart were reported by Dr. Theodore P. Wolfe, of New York City, to the American Psychiatric Association. When pleasure is felt, he found, there is an increased blood flow to the limbs and body surface and a decreased blood flow to the digestive organs. With unpleasurable feelings the reverse is true. This may be called, he explained, the scientific basis for the expression, "my heart dropped into my stomach." Merely the thought of moving an arm caused an increased blood flow to it, he found, although when someone else raised the patient's arm without his having thought about it, there was no increase of blood flow.

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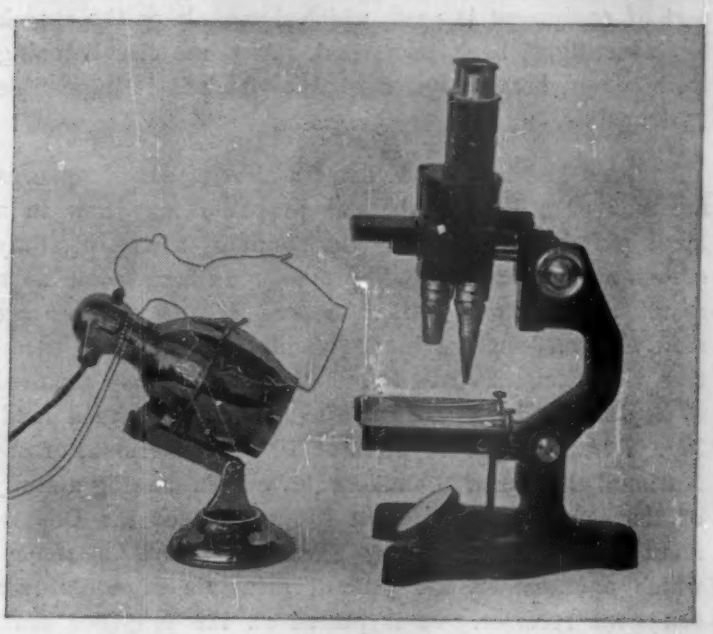

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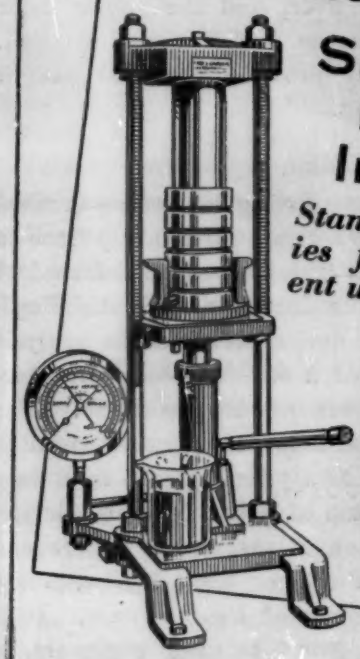

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SCIENCE NEWS

Science Service, Washington, D. C.

CREATION OF ARTIFICIAL RADIUM-LIKE ELEMENTS

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IF the process of making heavier radioactive elements out of lighter ones, which is reported to have been discovered by Professor Enrico Fermi in Italy, can be made efficient enough it may lead to a practical method of creating useful radioactive substances for medical purposes or scientific study.

When neutrons strike the nucleus of a light element they try to make trouble by kicking out an alpha particle or helium atom core. If this proves too difficult they bounce out themselves. Never in the past have they been found to join the nucleus in peace. Still, physicists have felt that in the stars or wherever else matter is built up many such peaceful unions must take place.

Now Professor Fermi reports that he has made neutrons stick to the heaviest element known, namely, uranium, which has almost 238 times the mass of hydrogen, the lightest element. If this prove true a new element will have been formed heavier than any known heretofore.

The heavy product seems to shake off an electron and this causes it to break the record for highest nuclear charge, namely 93. It may be that one of the lighter forms of uranium is attached. In this case the mass would be only 235 but the nuclear charge would still be 93.

Apparently this process may be very efficient because the uranium nucleus is so heavy, large and complex that the neutron can fritter away its excess energy within the uranium and then be too exhausted to leave. After a few seconds an electron leaves instead and then the fun begins. For the new element is radioactive and keeps changing by sending out alpha, beta and gamma rays until lead is formed.

The first problem that the new experiments are likely to solve is the old mystery of the source of the actinium series. Apparently nature has been doing slowly what Professor Fermi just learned to do rapidly.

Here in the United States we can produce neutrons a hundred times as copiously as could Fermi. It will be interesting to try the trick on other heavy atoms like thorium or ionium.—R. M. LANGER.

BLACK PHOSPHORUS MADE BY HIGH PRESSURE

BY squeezing atoms of phosphorus with pressures of seven tons to the square inch Professor P. W. Bridgman, research physicist of Harvard University, has just been able, for the first time in the history of science, to make this chemical element change its color from white to black by pressure alone.

Professor Bridgman's latest achievement in the field of high pressures, in which he is a world-famous authority, is reported in a letter to the editor of *The Physical Review* just released.

In the squeezing process, where the pressures become comparable with those found only inside the earth, the phosphorus changes from the dangerously inflammable waxy-white form which has to be kept under water to prevent its spontaneous burning, into a darkish, non-inflammable relative.

Phosphorus, while never found free in nature because of its affinity for other chemical elements, is widely distributed throughout the world. It is, as one example, an essential ingredient of the protoplasm of the human body.

INFANTILE PARALYSIS IN CALIFORNIA

THE biggest infantile paralysis epidemic since 1931, the year of the second largest outbreak in history, is threatening the country's health. Reports received by the U. S. Public Health Service show a large weekly increase in the number of cases and a greater total than was reported at this time in 1931, when that year's epidemic was already under way.

The outbreak this year has centered in Los Angeles and vicinity. Of the total of 179 new cases reported for the country as a whole for the week ending June 2, 163 were reported from California. For the previous week there were 118 cases reported from the whole country with 92 of them in California.

Health officials can not yet tell whether this year's outbreak will spread throughout the country and reach the proportions of the 1931 or 1916 epidemics. No better means of protection against the disease are available now than at the times of the previous outbreaks. Parents are warned to keep their children away from crowds where the danger of exposure is greatest, and to watch for symptoms of slight illness or indisposition so as to catch the disease in its early stages when treatment is most effective. New methods of treatment have improved the chances not only of saving the life of the infantile paralysis patient, but of warding off the paralysis and crippling deformities which were nearly universal sequels to the disease in former years.

In California blood serum from recovered patients is being used in the hope of giving protection against the disease.

AMEBIC DYSENTERY

HEALTH officials at the Conference of State and Provincial Health Authorities of North America, held at the headquarters of the U. S. Public Health Service in Washington, agreed that amebic dysentery is no more of a danger in Chicago now than in any other city in the country.

Discussion of the outbreak of last summer and fall brought out the following points:

Plumbing is the first line of defense against amebic dysentery.

The Chicago outbreak of amebic dysentery was the first due to infected water that has ever occurred in a civilian population anywhere at any time; the disease has always heretofore been traced to infected food

handlers. Sanitary inspection of plumbing when a building is erected is not enought to protect the public health. Such inspections should also be made at later dates to detect defects that may result from changes in the plumbing system after the building has been in use.

When Dr. Herman N. Bundesen, health commissioner of Chicago, described at the conference the fight made by the city against the amebic dysentery outbreak, he reported that 660 of the public buildings and hotels in the city had been rigidly inspected and all defects in plumbing corrected.

The plumbing in the Chicago hotel which was found responsible for the outbreak there is probably no different from plumbing installed in any building twenty to thirty years ago. Because of this and the fact that five out of every hundred persons in the general population are carriers of amebic dysentery, the disease may break out anywhere in the country at any time.

The disease did not spread throughout the country from the Chicago epidemic, no material outbreaks elsewhere having been traced to Chicago except those cases known to have been contracted in Chicago.

Amebic dysentery is probably a factor in the present increase of cases of so-called appendicitis. Many amebic dysentery cases are known to have been wrongly diagnosed as appendicitis and the mistaken diagnosis probably has not been detected in many more cases.

RAINS IN THE NORTHWEST

RAINS in the Northwest during the past few days should save the government millions of dollars in relief outlay, through enabling farmers to sow forage crops in land burned clear of small grain crops, thus salvaging at least a part of the cattle that would otherwise have to be sacrificed.

This does not mean, however, that there will be no need for relief in the Northwest, nor that the drought is broken. It merely means that the heavy rain, eagerly soaked up by the parched ground, puts the soil into condition for prompt germination of quick-growing second-crop plants which the farmers will be sowing as fast as they can get seed into the ground.

The rain, which in some places exceeded in twenty-four hours all the precipitation that had fallen during the previous three months, had nothing abnormal about it. It was an entirely normal, "old-fashioned" rain, brought by the same kind of a northwesterly storm that carries most of the summer weather in the Northwest and Midwest. The usual storm track follows a course up the valley of the Mackenzie River in northern Canada, along the Great Plains, and down the Missouri River Valley through the Midwest, usually recurving to the north and leaving the continent *via* the St. Lawrence Valley. The recent storm that brought the rain did not dip so deeply into the country as most of its tribe do.

It is really the drought, not the rain, that is the abnormal phenomenon. Ever since last autumn, the storm track has lain across northern Canada to the Hudson Bay region, thence southward through the Central Eastern states. Thus the East got an unprecedented winter, lasting until well into spring, while the West basked in a mild winter—which was nevertheless already a direfully threatening drought, bringing the menace, which has since been realized, of worse drought yet to come.

GRASSHOPPERS IN THE NORTHWEST

GRASSHOPPERS, which have been a menace second only to the drought itself in the Northwest, may receive a check in the Dakotas and Montana through the providential rains that have just fallen in that country.

W. R. Walton, of the Bureau of Entomology, explained to Science Service that the hordes of 'hoppers, which have not yet reached the flying stage in this northern part of their range, have been giving a desperate time to farmers and the crops of federal and state scientists who are in the field against them. Poison bait has been spread several times, but the air has been so dry that the moisture soon disappeared from the bait, so that the insects would not eat it.

The rain, Mr. Walton stated, will give the grasshopper fighters a breathing space, and longer time in which to carry on the battle. By improving moisture conditions, it will also probably keep the poison bait in edible condition longer.

The grasshopper situation in the West is very bad this season, Mr. Walton continued; worse, even, than had been expected. Undeterred by rains or anything else to favor man and injure them, they have been swarming in threatening hordes all down the Great Plains country as far as Texas, and thence through the southwestern states into California. In the southern areas they are already winged.

It is probable that 1934 will be remembered as a bad grasshopper year, as well as a year of unprecedented drought.

DETERMINATION OF GRADES OF COAL

EXACT specifications for every type of coal can now be had to show the household and industrial consumer the actual value of his purchases.

After seven years of effort towards complete classification, charts and tables have been published by the American Standards Association which list in every-day terms the different grades of coal and tell their respective values as fuels.

In ordering coal the cautious buyer can for the first time be assured of the quality and texture of his purchase by listing the specifications for whatever grade is adapted to his uses. The hit and miss method of buying is eliminated.

For instance, "(62–146)na" on an order blank would mean a coal containing 62 per cent. of fixed carbon, that part of the coal which determines its heating capacity, and 14,600 units of heat per pound. The parenthesis indicates that the coal is to be mineral-free, while "na" means non-agglutinating, that is, that the lumps will not stick together. These tables, in which the four main types, anthracite, bituminous, subbituminous and lignite, are divided up into thirteen grades, show all the characteristics of the various kinds, with symbols to represent each characteristic.

The specifications will be used by the NRA as a basis for classifying the output of mines.

In purchasing the 500,000,000 tons yearly output of over 6,000 mines in this country the average industrial or household consumer formerly had very little idea about the properties of coal which should be scientifically tabulated to show the one best adapted to any particular use. For over a hundred years many systems of classifying coal have been used, but none has been adopted generally.

THE SPEED OF AIRPLANES

AMERICAN planes fly at greater speeds than European planes both in mail and passenger service, but their speed is above the standard for greatest economy.

In America 150 miles an hour has been adopted as the cruising speed in general passenger flying and 200 miles per hour is achieved by aircraft carrying the mails, whereas in Europe 100 miles per hour is the average.

F. M. Green, of the Armstrong Siddeley Motors, Ltd., British manufacturers of airplane engines, who has reported to the Institute of Aeronautical Sciences a study of the most economical speeds at which airplanes may fly, finds that the speed of our planes is higher than that which gives the greatest economic efficiency.

He considers that the most economic speed is 130 miles per hour with the lowest safe horsepower of 62 hp. per thousand pounds weight. An average American eighteen-passenger plane has two 625 horsepower engines and weighs, fully loaded, about 20,000 pounds. This amounts to 62½ horsepower per 1,000 pounds, which is almost exactly the figure computed by Mr. Green for British planes. Therefore, according to his computations, our haste in getting from point to point makes waste insofar as fuel consumption goes.

He has also found, in examining the problem of economic speeds, that an increased altitude where the air becomes rarefied, raises the figure for greatest efficiency. At 7,500 feet 140 miles per hour is necessary to get the greatest value from the fuel consumed.

ITEMS

JUPITER'S supposed tenth moon has turned out to be only an asteroid or minor planet, one of hundreds of such small objects that circle in the heavens between the orbits of Mars and Jupiter. The Harvard College Observatory, American clearing house for astronomical information, has received a telegram from the first observer of the deceptive pin-point of light, Dr. H. M. Jeffers, of Lick Observatory, Calif., stating that further observations, as well as an orbit calculated by himself and his associate, A. B. Wyse, make it practically certain that the object is an asteroid. The addition of a possible tenth member to Jupiter's large family of moons was announced after scanning of photographs made on May 9 showed a minute fleck of light near the eighth satellite and having the same apparent motion. At the same time, however, the cautionary statement was made that the tiny celestial stranger might turn out to be an asteroid, as has since proved to be the case.

BOTH the northern and southern hemispheres of the sun are decorated by spots. A northern spot has a diameter of 19,000 miles, while one in the south measures 14,000 miles. Dr. Seth B. Nicholson, astronomer in charge of solar observations of the Carnegie Institution's Mount Wilson Observatory, at Mount Wilson, Calif., explained that there was a spot on the sun's face in April that was an earlier stage of the 14,000-mile diameter spot. At its maximum it was 35,000 miles in diameter including its outer portion of penumbra. A new small group of spots recently appeared on the sun, making four groups in all. Thus far these spots have produced no change in the earth's magnetic field.

PSYCHOLOGICAL methods so aided the recovery of 19 patients suffering from gastric disturbances that within six weeks they were eating anything they wanted without ill effects, it was reported to the New York Branch of the American Psychological Association by Dr. M. N. Chappell, of Columbia University, and his associates, Dr. J. J. Stefano, of Brooklyn Hospital, Dr. J. S. Rogerson and Dr. F. H. Pike, of Columbia University. The symptoms of the patients were caused by increased activity and tension of the digestive system which in turn was caused by worry and other emotions. Application of the psychological laws of learning and forgetting enabled the patients to forget the ideas upon which they had been dwelling, and so relieve the physical condition.

BUCKWHEAT beer and buckwheat soup regaled the inhabitants of ancient Tibet, no less than buckwheat cakes, according to Dr. Berthold Laufer, curator of anthropology at the Field Museum of Natural History, who has lately been looking into the origin of this supposedly most American of breakfast-cake materials. Our acquaintance with buckwheat is of about the same date as our acquaintance with America itself: buckwheat was introduced to Europe from the Orient some time in the fifteenth century, and to America in the sixteenth. Its original home seems to have been in the Himalayan uplands. There it has been in cultivation for at least two thousand years. Its cultivation spread first into China and Manchuria, where there are literary allusions to it of great antiquity. Buckwheat is not a wheat, or indeed any kind of a grain, in its botanical relations. It is a very close relative of the common smartweed of our roadsides.

THE slow, gradual chemical processes that decay leather over periods of many years have been speeded up to take place in a few months' time by U. S. Department of Agriculture chemists in efforts to discover and prevent what makes leather "age." By developing what is described as a heated gas chamber all the effects of decades of deterioration can be studied in a short time. This rapid analysis may permit the discovery of new methods of tanning which will lengthen the life of leather products. In reporting the tests R. W. Frey and C. W. Beebe, of the Bureau of Chemistry and Soils, say that their results agree with others in showing that even such small amounts of sulphur fumes as are present in the atmosphere of our cities are sufficient for the general breakdown of leather.

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Brings together recent developments in astronomy and its related fields in an effort to suggest a more intimate relationship between man and his cosmic environment. A large part of the book is based on the author's own researches toward a synthesis of geology, meteorology, radio engineering and astronomy into a new science—*cosmecology*. Attention is given to sun-spots, aurorae, cosmic clouds, cosmic rays, etc.

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW ELEMENT NO. 93

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THE heaviest element known to science—No. 93—is a substance whose properties make it a chemical relative of the hard, brittle metal manganese. The nature of the new element, together with proof of its existence, will appear in the forthcoming issue of *Nature* over the signature of its discoverer, Professor Enrico Fermi, of the Royal University, Rome. The first announcement of the discovery was made by Senator Mario Corbino before the Lincei Academy in Rome.

In describing his research, which added another element to the 92 already known to science, Professor Fermi stated that the crucial test was to add salts of the metal manganese to a solution of uranium after the latter had been bombarded with nutrons. Uranium is the dense "mother" element which breaks down by radioactive disintegration to produce a variety of lighter elements including radium.

Following the addition of manganese salts to the uranium fluid, a cloudy precipitate formed in the vessel and fell to the bottom. Most of the radioactivity floated down with this precipitate, indicating that a disintegrating substance, other than uranium, was present. The precipitate was a chemical salt of the new element No. 93. The addition of salts of other elements—uranium, lead and barium—while forming precipitates in some cases did not remove the radioactivity from the uranium mixture.

This precipitation test, Professor Fermi indicates, shows that element No. 93 probably is a heavy-weight relative, or homologue, of manganese. The experiment is not quite conclusive, however, in the sense that the yet-unfound elements 94 and 95 may have been present.

The use of chemical tests to prove radioactivity is not new. In the epoch-making experiments of Irene Curie and her husband, F. Joliot, last January, in which science for the first time produced artificial radioactivity, the French scientists shot the cores of helium atoms at boron nitride. By heating the boron nitride target in caustic soda, ammonia gas was formed. The radioactivity present then separated from the boron compound and was carried away as a gas with the ammonia vapor. The active substance in the ammonia, said the Joliots, was a form of nitrogen gas breaking down spontaneously by radioactive disintegration. Professor Fermi, in a comparable test, finds the radioactivity going off with the precipitate.

Element 93, as kin to manganese, fits into group seven of the periodic table of the elements after they are arranged into classes according to their characteristics. Companions of manganese and element 93 in group 7 are fluorine, chlorine, bromine, iodine and the rare substances masurium and rhenium.

THE ORIGIN OF COSMIC RAYS

COSMIC rays, the mysterious radiation which bombards the earth from all sides, may originate in the strange rare phenomena during which stars flare up with sudden bursts of energy that make them shine as bright as the planets.

This is the theory of cosmic ray origin advanced by Dr. W. Baade, of the Carnegie Institution's Mount Wilson Observatory, and Dr. F. Zwicky, of the California Institute of Technology, in a report published in the *Proceedings* of the National Academy of Sciences.

The special "erupting" stars which Drs. Baade and Zwicky believe cause cosmic rays are called super-novae. After traveling through space for eons of astronomical time they suddenly flare up and reach a brightness which, on occasions, has rivaled that brightest of all stars, Sirius. Some super-novae in distant nebulae produce as much light as does the whole star system which contains them. In the short space of a few years the shining splendor of the novae type stars fades away to their former obscurity. Novae flare-ups are rare occurrences which last about as long in comparison with the millions of years in astronomical time as the fleeting flare of a rocket compares with a century.

Super-novae stars, according to Drs. Baade and Zwicky, are ordinary stars which blow up like a bursting shell. The velocity of expansion of the star may, in some cases, be nearly that of the speed of light. Some stars, in the process, may lose over half their mass by radiating it away into space. Visible and ultra-violet light are known to come off in the star eruption. It is suggested now that cosmic rays may be emitted at the same time.

Cosmic ray observers are requested to call attention promptly to any systematic intensity changes that last even a few days. If such information were obtained quickly enough astronomers could push the search for possible novae stars. Cosmic ray intensities fluctuating over a period of years in rhythm with the appearance of super-novae stars would be strong support for the new hypothesis.

Applying their theory of novae bursts to cosmic rays, Drs. Baade and Zwicky point out that in all the discussion about cosmic rays there is only one point on which all investigators—Millikan, Compton, Regener, Hess and others—agree: cosmic rays originate outside the star system which contains the sun and its companion earth.

This general agreement on the extra-galactic origin of cosmic rays fits the hypothesis of the emission of cosmic rays by super-novae stars. Cosmic rays do not come from within our own star system, for the simple reason that no super-nova flare-up has occurred near the neighborhood of the earth during the twenty years during which the rays have been studied systematically. Moreover, theoretical deductions on the possible intensities of cosmic rays, which would come out of erupting novae stars, correspond to the observed intensities.

Astronomical calculations lead also to the belief that super-novae type stars should occur in any particular star system like our Milky Way once in 1,000 years on the average. Sometime between 1934 and 2934, there

fore, investigators of the future—if they are still interested in cosmic rays—will probably have a chance to test the Baade-Zwicky theory. During the next thousand years one star in the system containing the sun should flare up and become a super-nova. If this happens, according to Drs. Baade and Zwicky, cosmic ray intensities should increase a thousand fold.

It will not be necessary, however, to wait 1,000 years for a test of the new hypothesis. There are about 1,000 star systems, or nebulae, which are comparatively near the earth. Every year, therefore, some one of these ought to have a star eruption. Such annual eruptions should be sufficient to change cosmic ray intensities on the earth by about one per cent. over a period of a few days.

EARTHQUAKES AND SOAP BUBBLES

THERE is a very close analogy between the passage of earthquake waves through the earth's crust and the passage of light waves through a soap bubble. The analogy is only skin deep, but it is for that reason all the more significant.

When the film in a soap bubble becomes so thin that it matches a wave-length of visible light the light no longer passes easily through it, but suffers from so-called interference effects which manifest themselves in the brilliant colors seen in thin soap films.

A leading geophysicist, Dr. Beno Gutenberg, and an expert on light waves, Dr. P. S. Epstein, both of the California Institute of Technology, in the course of a conversation drifted over to the analogies in their two fields. They noticed that the earth's crust has approximately the thickness (about 25 miles on the average) of one wave-length of an ordinary earthquake. The result of this conversation was of scientific importance because they worked out a method of telling the direction of the earthquake ray through the earth from its altered direction as indicated by recording instruments on the surface of the crust.

The calculation in the case of earth motions is more complicated than in the case of light because the elastic motions of the earth have both longitudinal and transverse vibrations, while light waves are exclusively transverse. This means that a single earthquake impulse striking the crust from the denser interior of the earth is broken up into four rays while there would result only two in the case of light.

The various earthquake beams soon undergo further reflections and splittings and result in a maze of interfering vibrations which make an earthquake so hard to analyze in detail. Earlier theories failed to predict the true behavior of earthquake waves in their passage through the crust and the best results were obtained by disregarding the junction between the crust and the core. This puzzling result is shown to be quite in accordance with the theory by the calculations of Drs. Gutenberg and Epstein.

THE GROWTH OF ANIMALS AND PLANTS IN HEAVY WATER

EXPERIMENTAL evidence that plants and animals grow more slowly in the new "heavy water" than in the ordinary kind which they ordinarily meet in nature may come about because the protein in them will not absorb as much.

Speaking before the American Chemical Society meeting at Berkeley with the American Association for the Advancement of Science, Drs. H. Q. Woodard and L. C. Chesley, research scientists of Memorial Hospital, New York City, described experiments on measuring the absorption of heavy water by the protein substance—gelatin.

Standard amounts of gelatin absorbed 20 per cent. less heavy water by volume in a given time than did equal amounts in ordinary water.

Ninety per cent. heavy water was used. This was supplied by Dr. Harold C. Urey, of Columbia University, who was one of the trio of original discoverers of the heavy, double-weight form of hydrogen called deuterium.

Two atoms of deuterium combining with one atom of oxygen forms heavy water just as two atoms of ordinary, light-weight hydrogen will unite with one atom of oxygen to form the kind of water man drinks.

Drs. Woodard and Chesley point out that since the absorbing of water plays an important part in life processes, it is important to compare the swelling of protein material in heavy and ordinary water.

The results of these experiments are of interest because of their relation to those biological processes in which absorption of water plays an important part.

VITAMIN D

FEEDING a baby milk to which vitamin D has been added may be a good way to give him this important, rickets-preventing vitamin, but such milk can not at present be relied on as sole source of the vitamin.

This opinion, important to mothers and physicians alike, was expressed by baby specialists and nutrition experts at the meeting in Cleveland of the American Association of Medical Milk Commissions and the Certified Milk Producers' Association of America.

The reasons for this warning were brought out by Professor Julius H. Hess, of the University of Illinois. In the first place, the amount of vitamin D in a quart of milk varies under present methods of manufacture and can not be known definitely for any given quart. This is partly because testing for vitamin D in milk is so expensive that even large dairies can only afford to do it once a month, and partly because there are no uniform and satisfactory standards for vitamin D as yet available. Different research groups use different standard units and different methods of determining them and just what they mean in terms of rickets-prevention in a human infant is a moot question. In the second place, babies and children vary in their susceptibility to rickets, so the amount of vitamin necessary to prevent the disease must be determined for each child by his own physician. Incidentally, Dr. Hess pointed out that rickets is no longer a scourge. Nowadays comparatively few children develop it.

A little vitamin D in milk is probably good for all growing children and for adults as well, according to Dr. Edwin T. Wyman, of the Harvard Medical School. The present tendency to add vitamin D to many foods

was criticized. Professor E. V. McCollum, of the Johns Hopkins Medical School, is of the opinion that "certainly not more than two and probably only one food should carry vitamin D." Milk and bread should be the two, and if only one is used as carrier of extra vitamin D, it should be milk.

HAY FEVER AND TIMOTHY FLOWERS

HAY fever victims, who owe their distress to their susceptibility to timothy pollen, are the indirect beneficiaries of researches on the flowering habit of timothy conducted by Dr. Morgan W. Evans, of the Timothy Breeding Station at North Ridgeville, Ohio, as reported in *The American Journal of Botany*.

The investigation embraced studies on the flowering habits of the plant, methods of collecting the pollen, and the effect of fertilizers, climatic conditions and the time of year on the production of pollen.

Timothy blooms, according to Dr. Evans, at very definite periods of the day, usually the largest number of florets opening about sunrise. The pollen, from which extracts for the alleviation of hay fever are made, may be collected by harvesting the stems on afternoons during the flowering season and placing them with the heads over sheets of paper. On the following morning the florets usually bloom in much the same way as in the field. The pollen may then be shaken off and collected on the paper.

The largest yields of pollen, Dr. Evans explains, are usually produced on days when the temperature is about normal or above normal, and when there is no rainfall and a relatively high percentage of sunshine. So long as favorable weather continues, the process of blooming occurs at about the same time each day during the flowering season. When the weather becomes cloudy or rainy, and especially if the temperature becomes subnormal, the process of blooming may be suppressed for one or even two days. When favorable weather conditions return, the florets bloom in unusually large numbers.

By growing early and late varieties of timothy, Dr. Evans was able to collect pollen for two weeks longer than usual.

ITEMS

A SHARP earthquake rocked the region of the Kurile Islands between Japan and Kamchatka on June 12, at 8:51 P. M., eastern standard time. From telegraphic reports to Science Service, experts of the U. S. Coast and Geodetic Survey located the epicenter of the quake at 46 degrees north latitude; 150 degrees east longitude. This would fix the center of the disturbance on or near the island of Urup, northeast of Japan and southwest of the Kurile Islands.

NEGATIVE particles of electricity—the electrons—are being "kicked" down evacuated glass tubes at the University of Virginia with speed reaching 94 per cent. that of light. Light travels 186,000 miles a second, or, 667,600,000 miles an hour. Electrons speeded up in the apparatus of Professor J. W. Beams and H. Trotter, Jr., have reached velocities of 174,840 miles a second. Reporting their experiments in *The Physical Review*, the method of obtaining very high speed particles for use in research on bombarding atoms where large energies of impact are required is described. Electrons having kinetic energy comparable with that achieved if a million volts of storage batteries were connected in series, are obtained by the use of only 300,000 volts alternating current from power lines. Or, if a small Van de Graaff type electric generator is employed, electrons having energies well over a million volts are obtained with only 30,000 volts. The apparatus for this last case increases the energy by a factor of over 40. The method, which makes this high energy gain possible, is to apply the small voltages at just the right times as electrons pass through the tube.

THE mild winter of 1933–34 in the western National Park area may be of doubtful value from the standpoint of the wild animals. Not only was the weather much milder than usual throughout the entire northern range, but the snowfall was much less heavy than in former years. As a result, the animals wintered well and sought the higher altitudes much earlier than usual this spring. Unfortunately, however, there is cause for concern in the drought conditions that have followed the mild winter, and fear is expressed by park officials that should a hard winter follow these drought conditions the wild animals may suffer severely. A mild winter always means less forage produced, greater utilization of the range, and a higher birth rate among the wild animals, thus complicating the situation.

AN unusual case of "stones in the brain" was reported before the meeting of the American Psychiatric Association by Dr. Jacob Kasanin, of the Rhode Island State Hospital for Mental Disease. This condition is a disease of the blood vessels of the brain in which calcium, the mineral found in bones, is precipitated into the small arteries. Physicians believe the disease tends to run in families and that it is associated with epilepsy and mental deficiency. It should be easy to diagnose the condition by x-ray pictures, Dr. Kasanin said. Only about half-a-dozen such cases have been reported in America, and the first ones were thought from the patients' symptoms and behavior to be brain tumors. The underlying cause of the condition is not known, except that it is some degenerative condition of the brain.

DR. T. D. STEWART, physical anthropologist of the Smithsonian Institution, is making a study of the directions in which hair grows over the whole body. He is comparing man in this respect with various members of the anthropoid family, the gorillas, chimpanzees, orangs. Orang-outans have a somewhat similar pattern of hair to the human cowlick, but it occurs on the back of the head, not the crown. The cowlick is a point of divergence, at which the hair streams out in all directions. The cowlick is the most conspicuous divergence of hair in a human being, but the hair direction pattern of the back is perhaps even more striking. The hairs start from both sides and converge at about the middle of the spine. In anthropoid apes the back hair streams downward from the back of the neck and shoulders, suggesting a continuation of the head hair pattern.

SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS READ BEFORE THE BERKELEY MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

(*Copyright by Science Service*)

DR. THOMAS H. JOHNSON, assistant director of the Bartol Research Foundation at Swarthmore, Pennsylvania, reported that "it is now possible to say with considerable certainty that the particle part of the cosmic rays accounts for from 90 to 98 per cent. of the total intensity at the top of the atmosphere. It is highly probable, therefore, that by far the greater part of the cosmic radiation consists of positive particles and there is at the most but a few per cent. to be accounted for in some other way, possibly as a gamma radiation." Dr. Johnson bases his contention that cosmic rays are really positively charged particles on the clearing up of the three major objections to the corpuscular theory of the radiation's nature. The former objections, he indicated, were: First, that the particles did not have great enough energies to account for their often remarkable penetration through lead and other dense materials. Theory demanded that the rays (if they were particles) should have energies equal to 10,000 million volts. Most of the cosmic rays observed had only 600 million volts energy. Second, the stopping of the rays as they came through the atmosphere of the earth was much too great. The absorption of cosmic rays, providing they were corpuscular in nature, was 25 times what it ought to be on theory. Third, the amount of absorption as indicated by the range of the atom debris, which the rays knocked out of atoms inside cosmic ray instruments, did not vary with the energy of the incoming radiation. If the theory were correct, the absorption coefficient ought to change with energy. Observations have proved that for great differences of cosmic ray energy the absorption is independent of the energy, or not related to it. The first and second objections, said Dr. Johnson, have been advanced by Professor Robert A. Millikan and his colleagues of the California Institute of Technology. The third is a new mystery advanced by himself. According to Dr. Johnson, all three objections to the particle nature of cosmic rays may be solved if one realizes that the incoming corpuscular rays make direct hits on the nuclei of atoms in the air. These direct impacts cause the "showers" or "bursts" of cosmic rays detected by many observers. He stated that it is probable that every time one of the high-energy primary particle rays hits an atom nucleus it creates 25 secondary rays of the lower energy. The collision would account for the seemingly 25 times too great absorption of the rays and indicate that scientists have only a twenty-five to one chance of detecting the incoming high-speed particle. The secondary rays produced would be the "soft" 600-million-volt rays observed by Carl Anderson and others in the Wilson cloud chamber apparatus. The nucleus impact phenomenon is a chance occurrence. For still more penetrating rays with energies of 100,000 volts a direct hit would produce about 1,700 secondary rays with energies commonly observed—the 600 million volt rays. With all this mixture of secondary radiation present in the instruments it would be a rare, lucky chance indeed which would demonstrate the existence of a really high-energy particle even though a large fraction of incoming radiation is of the positive particle type. "Shower production seems to be able," Dr. Johnson concluded, "to explain away the principal difficulties which have been raised with the corpuscular hypothesis and it is extremely unlikely that any other hypothesis would be able, in such a simple manner, to correlate so many cosmic ray effects. In fact, I think we may say that this hypothesis is now substantially proved, as an explanation of the principal part of cosmic radiation."

DR. ROBERT A. MILLIKAN, of the California Institute of Technology, presented to the American Physical Society his reasons for believing that cosmic rays are mostly photons; that is, that they constitute a phenomenon like ordinary light, heat and x-rays. Experimentally, cosmic ray observations are now in good agreement among the various investigators. It is in the interpretations of the observed data that opinions and theories differ. Dr. Millikan concludes that practically all the electrical disturbance caused in the earth's atmosphere by cosmic rays is due to the passage of positive and negative electrons, most of these particles being born of photons and electrons in the atmosphere. He finds that not more than three or four per cent. of the cosmic ray electrical disturbance, or ionization, found at sea-level is due to electrons that come in from outer space; nevertheless, he believes that these electrons are responsible for the variations in cosmic ray intensities found over the various parts of the earth. The energy of the photons which give rise to most of the atmosphere's ionization is about 130 million volts, although it may be 100 million volts more or less than that. Dr. R. M. Langer, of the California Institute of Technology, suggested that it may be necessary to credit cosmic ray effects to some kind of radiation yet unappreciated in order to obtain an adequate explanation. Perhaps even the newly discovered neutron may play a part.

DESCRIBING recent experiments performed jointly with Dr. L. R. Hafstad, Dr. M. A. Tuve, of the Carnegie Institution of Washington, told of driving deutons, the hearts of atoms of heavy hydrogen, into a gas composed of the same substance. The atomic impacts drove streams of protons (the positive cores of ordinary hydrogen) out of the apparatus with varying ranges of flight. This difference in the length of path which the protons travel does not fit in with atomic theory. Knowing the weights of the atomic particles involved, Dr. Tuve suggested that what is needed to explain the strange phenomena is a neutron of mass two, twice as heavy as the ordinary kind. The reaction which may happen is that two heavy

hydrogen cores—the deutons—combine and then turn into two light hydrogen atoms and one neutron of mass two. The existence of an over-weight neutron would also reconcile some of the differences of opinion about the exact weight of the ordinary neutron. Mixed up in this controversy is the possibility that there exists also a little, or light-weight neutron, called provisionally the neutrino. The neutrino, from the Italian, was suggested some years ago by Professor E. Fermi, who recently made element No. 93. The English version of neutrino would be neutrette. While the existence of the neutrino has not yet been proved, some of its properties have been predicted. A neutrino would be an electrically neutral particle like the neutron, but would weigh only about as much as an electron, that is, 1/1800 the mass of a hydrogen atom. Physicists foresee that like most of the atomic particles the neutrino would spin on some axis (like the earth) as it moves. But they predict also that the spin might be either clockwise or counterclockwise. The neutrino is spinning one way. Its twin, spinning in the reverse direction, has been given the name of anti-neutrino, although it too is yet unfound. The spin of the neutrino and the anti-neutrino would make it possible to account for some of the magnetic properties in atoms.

PLANS are being pushed at the University of California and the Massachusetts Institute of Technology for higher-powered atomic apparatus. Preliminary details were given at the sessions of the American Physical Society, meeting in Berkeley jointly with the association. Immediate and simple changes in the atom-bombarding apparatus of Professor E. O. Lawrence and his colleagues at the University of California will raise its voltage from its present five million rating to twenty million volts. The present equipment, in which particles are speeded up by oscillating electricity and kept inside the apparatus by the influence of an 85-ton magnet, will shortly be quadrupled in diameter. Within a year or two a more powerful machine than the giant ten million volt electrostatic generator of Dr. Robert J. Van de Graaff will be made ready at Round Hill, Massachusetts. About thirty million volts driving force for atom "bullets" is expected from this new machine, which will be built in a steel tank evacuated of all air to create the necessary insulation. Despite its great increase in power over present-day apparatus it will occupy less space than the ten million volt machine now in use which is so large that an airship hangar is its home. The steel tank will be only about ten feet in diameter and twenty-five feet high. A small experimental edition of the vacuum-surrounded generator is now under construction in Cambridge, Massachusetts. A novel feature of the apparatus will be a chain belt made of stainless steel, nickel and porcelain for carrying electric charges up to the large spheres.

DESIROUS of increasing their supply of neutrons, which is already the world's greatest, California experimenters plan to increase neutron emission for atomic investigation some 1,000-fold. Hydrogen will be packed into the chamber of Professor Lawrence. The sides of the chamber will be lined with the metal beryllium, which, when bombarded, will yield immense quantities of the desired neutrons. Since neutrons have just been shown in Italian experiments to be extremely effective agents in producing artificial radioactivity in ordinary stable elements it is hoped that the new technique will make possible new and practically useful reactions of new elements and artificial radioactivity.

OXYGEN in the atomic state has been discovered for the first time in the chromosphere of the sun, by Harold D. Babcock and Horace W. Babcock, of the Mount Wilson Observatory. Their work was reported before the meeting of the Astronomical Society of the Pacific. The presence of oxygen in this portion of the sun was detected by means of a spectrograph, the instrument commonly used for studying light after it has been split into its various component colors, which disclose the chemical elements in the light-source by characteristic bright and dark lines. The oxygen line was found in the green part of the spectrum.

FIRST reports on a way to check the composition of the sun during periods of total eclipses were presented before the Astronomical Society of the Pacific, meeting jointly with the association. Dr. Willi M. Cohn, University of California, and Josef J. Johnson, California Institute of Technology, described experiments on measuring the polarization of sunlight during the total eclipse of the sun on February 14, 1934, which was observed only from Losap Island in the South Seas. Dr. Cohn and Mr. Johnson were two members of a group invited by the Japanese Government to accompany the expedition of that government to Losap Island. "Measurements of the percentage of polarized light received from the various parts of the corona," according to Mr. Johnson, "have an important bearing on the study of the distribution of matter in the solar corona." When the moon interposes itself between the sun and earth so that it casts a shadow and reveals the shining incandescent gas of the corona the light received on earth does not vibrate in its normal helter-skelter fashion at right angles to its line of transmission. More of it vibrates one way than another. This inequality of vibration is partial "plane" polarization. The helter-skelter vibration is called "circular" polarization. Dr. Cohn determined polarization by photographic methods while Mr. Johnson used visual recording.

PRODUCING extreme cold only fifteen hundredths of a degree above absolute zero, the "farthest south" of temperature, Drs. W. F. Giauque and D. P. MacDougall, of the University of California, find that gold remains electrically steadfast under this extreme treatment and does not become less resistant to electricity as do all other metals so far tested. Lead, tin and other metals cooled to near the lower limit of temperature became superconducting, that is, an electrical current would flow nearly unimpeded in a coil for hours. Failure of gold to act in this way is of great interest as there is a possibility that it may become superconducting in the mere fraction of a degree of temperature remaining for cold

to be pushed. The record low achieved so far by Drs. Giauque and MacDougall is a tenth of a degree above absolute zero. This is nearly the world's record cold.

AVIATORS preparing for high altitude flights may in future spend an hour or more in breathing pure oxygen before taking off. Experiments with rats at the University of Southern California show that by such means the animal body can store up oxygen against a time of need. Experiments substantiating this fact were reported by Professor Francis Marsh Baldwin and Harold B. Robertson. White rats, which have physiological responses very similar to man, were made to breathe pure oxygen for twenty-five, forty, seventy, and one hundred and thirty minutes and were subjected to atmospheric conditions comparable to those found at altitudes of from six and one half to eight miles. Seventy minutes of oxygen breathing gave the greatest resistance to subsequent oxygen-want in high altitude conditions. Twenty-five minutes was of considerable value. Forty minutes of oxygen breathing was of less value than either twenty-five or seventy, which is explained as being probably due to a shift in body processes similar to the adjustment a runner makes when he gets his "second wind." Exposure to oxygen for longer than seventy minutes decreased ability to withstand low barometric pressures.

THE latest step in the investigation of whooping cough is the discovery reported by Dr. John J. Miller, Jr., National Research Council fellow at the University of California, that pertussis endoantigen, developed for whooping cough treatment, promises to provide a means of diagnosing this disease rapidly and with certainty. Within the last year whooping cough has been produced in both apes and man by inoculation with pure cultures of the bacillus *Hemophilus pertussis*, clinching the demonstration that this germ causes the disease. Manufactured with the aid of the germ at the University of California by Professor A. P. Krueger, the endoantigen has proved effective in subduing the worst ravages of whooping cough in many cases.

DOUBT was cast upon the common idea that bacteria, or filterable viruses, cause colds or other respiratory diseases such as pharyngitis, laryngitis, bronchitis and even pneumonia. Drs. William J. Kerr and John B. Lagen, of the University of California, after unsuccessful efforts to give colds to men volunteers living under ideal conditions of temperature and humidity, assigned the cause of the common cold, not to infection, but to "the excessive cooling power of the air at certain times, acting upon the body when the skin pores are open through excessive exertion, fatigue or environmental factors themselves, all of which allow heat to dissipate readily through the skin."

DR. JAMES F. RINEHART, of the University of California Medical School, using his own and other experiments, reported that vitamin C deficiency may be an important factor in the cause of rheumatic fever and rheumatoid arthritis. These are illnesses that usually attack undernourished children just when they are growing fastest. Their joints become acutely painful, swollen and reddened, and frequently heart injuries are produced which are a handicap for life. Rheumatic fever usually comes in the spring and attacks the children of the poor in cities. If the proper food containing vitamin C is not eaten, the body seems to be peculiarly susceptible to infection by the hemolytic streptococcus germ, and the combined result is disease. Experiments upon animals uphold this idea and convince Dr. Rinehart that the germ infection alone is not the complete cause. The next step expected is the application of the discovery to the actual prevention and treatment of human cases.

A VAST number of gland secretions capable of influencing the human body in a multitude of ways will be discovered in the future, was predicted by Professor Vincent du Vigneaud, of the George Washington Medical School. Already more than a dozen of these hormones are known. Six have been isolated in pure crystal form and two of them, epinephrine and thyroxine, have been manufactured in the chemical laboratory with entire satisfaction. Like vitamins, only very small amounts of hormones are required to produce large effects. In tearing the hormones apart chemically in hope of discovering their composition, remarkable relationships among substances in the body have been found. For example, the female sex hormone shows relationship to the male sex hormone, to a bile acid, to cholesterol, to ergosterol, to the sunshine vitamin D, to strophanthin (a drug used as a heart tonic), and even to the substance in coal tar which causes certain types of cancer through chronic irritation of the skin.

GREAT BRITAIN, no less than the United States is undertaking an intensive study of her land problems with a view to the best utilization of its relatively limited surface. Dr. L. Dudley Stamp, chairman of the Commission on Land Utilization in Great Britain, told how the task is being begun. Great Britain, with a large industrial population on an area not as large as some of our states in the West, faces a problem exactly opposite that of the United States. The land can not raise a surplus of food; the question is one of raising enough, and increasing acreage and yield-per-acre instead of cutting down. The first step in the British program of land use planning has been to make a minutely detailed survey of the entire island, building a very large-scale map. In this work 22,000 volunteer surveyors have been engaged, and in addition nearly a quarter of a million young people, mostly students, have had some part.

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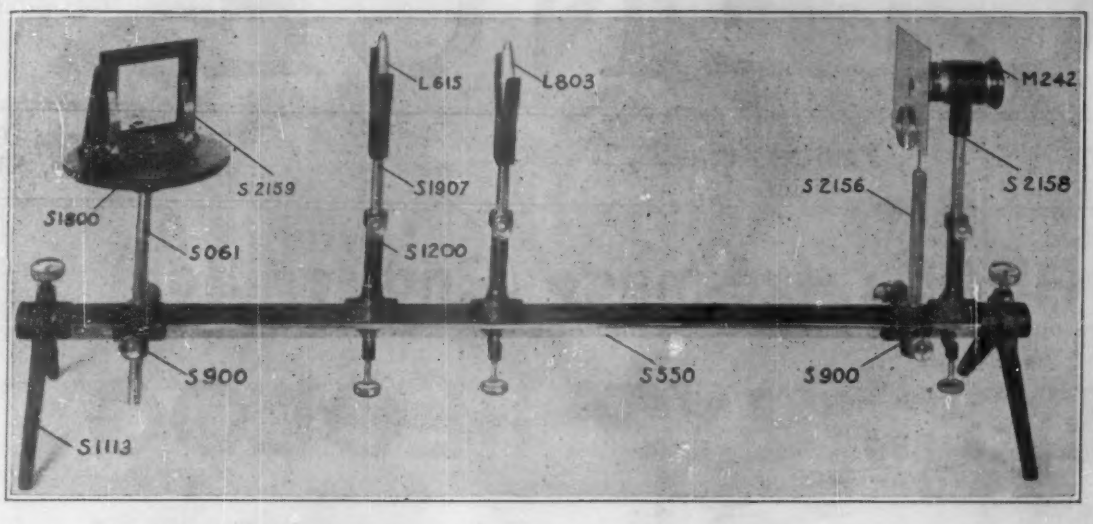

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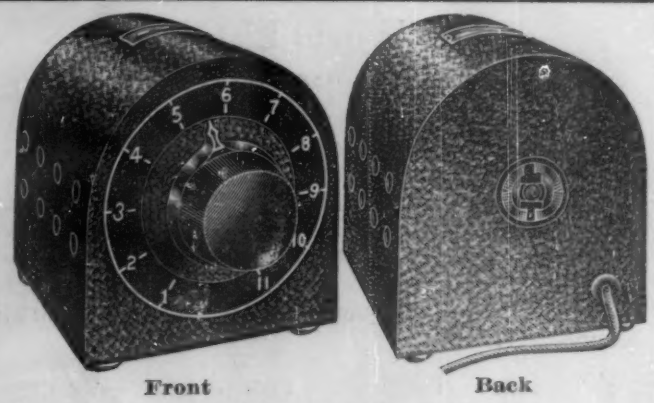

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